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U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 115.

A. C. TRUE, Director.

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PROCEEDINGS

OF THE

FIFTEENTH ANNUAL CONVENTION

OF THE ASSOCIATION OF

American Agricultural Colleges and Experiment Stations

HELD AT

WASHINGTON, D. C.,
NOVEMBER 12–14, 1901.

EDITED BY

A. C. TRUE and **W. H. BEAL**, for the Office of Experiment Stations

AND

H. H. GOODELL, for the Executive Committee of the Association

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

THE AGRICULTURAL COLLEGES.

Alabama—*Auburn:* Charles C. Thach.* *Normal:* Wm. H. Councill.* *Tuskegee:* Booker T. Washington.†

Arizona—*Tucson:* F. Yale Adams.‡

Arkansas—*Fayetteville:* Harrison Randolph.*

California—*Berkeley:* Benjamin Ide Wheeler.*

Colorado—*Fort Collins:* Barton O. Aylesworth.*

Connecticut—*Storrs:* R. W. Stimson.‡

Delaware—*Newark:* Geo. A. Harter.* *Dover:* W. C. Jason.*

Florida—*Lake City:* Thos. H. Taliaferro.* *Tallahassee:* Nathan B. Young.*

Georgia—*Athens:* H. C. White.* *College:* R. R. Wright.*

Idaho—*Moscow:* J. A. McLean.*

Illinois—*Urbana:* Andrew S. Draper.*

Indiana—*Lafayette:* Winthrop Ellsworth Stone.*

Iowa—*Ames:* W. M. Beardshear.*

Kansas—*Manhattan:* Ernest R. Nichols.*

Kentucky—*Lexington:* J. K. Patterson.* *Frankfort:* James S. Hathaway.*

Louisiana—*Baton Rouge:* Thos. D. Boyd.* *New Orleans:* H. A. Hill.*

Maine—*Orono:* George Emery Fellows.*

Maryland—*College Park:* R. W. Silvester.*

Massachusetts—*Amherst:* Henry H. Goodell.*

Michigan—*Agricultural College:* J. L. Snyder.*

Minnesota—*St. Anthony Park, St. Paul:* Cyrus Northrop.*

Mississippi—*Agricultural College:* J. C. Hardy.* *Westside:* W. H. Lanier.*

Missouri—*Columbia:* R. H. Jesse.* *Jefferson City:* E. A. Clarke.*

Montana—*Bozeman:* James Reid.*

Nebraska—*Lincoln:* E. Benjamin Andrews.§

Nevada—*Reno:* Joseph E. Stubbs.*

New Hampshire—*Durham:* Charles S. Murkland.*

New Jersey—*New Brunswick:* Austin Scott.*

New Mexico—*Mesilla Park:* Luther Foster.*

New York—*Ithaca:* Jacob Gould Schurman.*

North Carolina—*West Raleigh:* G. T. Winston.* *Greensboro:* James B. Dudley.

North Dakota—*Agricultural College:* J. H. Worst.*

Ohio—*Columbus:* William Oxley Thompson.*

Oklahoma—*Stillwater:* Angelo C. Scott.* *Langston:* Inman E. Page.*

Oregon—*Corvallis:* Thos. M. Gatch.*

Pennsylvania—*State College:* George W. Atherton.*

Rhode Island—*Kingston:*

South Carolina—*Clemson College:* Henry S. Hartzog.* *Orangeburg:* Thomas E. Miller.*

South Dakota—*Brookings:* J. W. Heston.*

Tennessee—*Knoxville:* Chas. W. Dabney.*

Texas—*College Station:* David F. Houston.* *Prairieview:* E. L. Blackshear.*

Utah—*Logan:* W. J. Kerr.*

Vermont—*Burlington:* M. H. Buckham.*

Virginia—*Blacksburg:* J. M. McBryde.* *Hampton:* H. B. Frissell.*

Washington—*Pullman:* E. A. Bryan.*

West Virginia—*Morgantown:* D. B. Purinton.* *Institute:* J. McHenry Jones.*

Wisconsin—*Madison:* E. A. Birge.‡

Wyoming—*Laramie:* Elmer E. Smiley.*

---

* President. † Principal. ‡ Acting President. § Chancellor.

U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 115.

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1862 1889

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1902.

OFFICE OF EXPERIMENT STATIONS.

A. C. True, Ph. D.—*Director.*
E. W. Allen, Ph. D.—*Assistant Director and Editor of Experiment Station Record.*
W. H. Beal—*Chief of Editorial Division.*
C. E. Johnston—*Chief Clerk.*

EDITORIAL DEPARTMENTS.

E. W. Allen, Ph. D., and H. W. Lawson—*Chemistry, Dairy Farming, and Dairying.*
W. H. Beal—*Agricultural Physics and Engineering.*
Walter H. Evans, Ph. D.—*Botany and Diseases of Plants.*
C. F. Langworthy, Ph. D.—*Foods and Animal Production.*
J. I. Schulte—*Field Crops.*
E. V. Wilcox, Ph. D.—*Entomology and Veterinary Science.*
C. B. Smith—*Horticulture.*
D. J. Crosby—*Agricultural Institutions.*

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., May 15, 1902.

Sir: I have the honor to transmit herewith for publication Bulletin No. 115 of this Office, containing the proceedings of the Fifteenth Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held at Washington, D. C., November 12–14, 1901.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

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OFFICERS AND COMMITTEES OF THE ASSOCIATION.

President.

W. M. Liggett, of Minnesota.

Vice-Presidents.

W. O. Thompson, of Ohio; J. H. Washburn, of Rhode Island;
H. J. Waters, of Missouri; J. H. Worst, of North Dakota;
J. C. Hardy, of Mississippi.

Secretary and Treasurer.

E. B. Voorhees, of New Jersey.

Bibliographer.

A. C. True, of Washington, D. C.

Executive Committee.

H. H. Goodell, of Massachusetts, *Chair.;* Alexis Cope, of Ohio;
G. W. Atherton, of Pennsylvania; H. C. White, of Georgia;
Ex officio: The President; the Junior Ex-President (A. W. Harris); the Secretary.

OFFICERS OF SECTIONS.

College Work.

J. L. Snyder, of Michigan, *Chair.;* W. E. Stone, of Indiana, *Secretary.*

Agriculture and Chemistry.

H. J. Waters, of Missouri, *Chair.;* C. G. Hopkins, of Illinois, *Secretary.*

Horticulture and Botany.

J. Craig, of New York, *Chair.;* Aven Nelson, of Wyoming, *Secretary.*

Entomology.

F. M. Webster, of Ohio, *Chair.;* H. E. Summers, of Iowa, *Secretary.*

Mechanic Arts.

H. W. Tyler, of Massachusetts, *Chair.;* F. P. Anderson, of Kentucky, *Secretary.*

COMMITTEES.

Indexing Agricultural Literature.

A. C. True, of Washington, D. C., *Chair.;* T. F. Hunt, of Ohio;
W. M. Hays, of Minnesota; E. Davenport, of Illinois;
Josephine A. Clark, Librarian, U. S. Dept. of Agriculture.

Methods of Teaching Agriculture.

J. H. Connell, of Texas, *Chair.;*
T. F. Hunt, of Ohio;
A. C. True, of Washington, D. C.;
H. T. French, of Idaho;
H. H. Wing, of New York.

Graduate Study at Washington.

C. Northrop, of Minnesota, *Chair.;*
M. H. Buckham, of Vermont;
J. H. Washburn, of Rhode Island;
J. E. Stubbs, of Nevada;
A. C. True, of Washington, D. C.;
C. W. Dabney, of Tennessee;
W. O. Thompson, of Ohio.

Uniform Fertilizer Laws.

H. J. Wheeler, of Rhode Island, *Chair.;*
C. D. Woods, of Maine;
H. P. Armsby, of Pennsylvania;
E. H. Jenkins, of Connecticut;
M. A. Scovell, of Kentucky.

Military Instruction in Land-Grant Colleges.

G. W. Atherton, of Pennsylvania, *Chair.;*
A. W. Harris, of Maine;
C. W. Dabney, of Tennessee;
Alexis Cope, of Ohio;
H. H. Goodell, of Massachusetts;
R. H. Jesse, of Missouri;
H. C. White, of Georgia.

Cooperation between Stations and U. S. Department of Agricultvre.

E. A. Bryan, of Washington, *Chair.;*
H. H. Goodell, of Massachusetts;
B. T. Galloway, of Washington, D. C.;
W. A. Henry, of Wisconsin;
H. J. Waters, of Missouri;
L. G. Carpenter, of Colorado

Pure-Food Legislation.

W. A. Withers, of North Carolina, *Chair.;*
W. Frear, of Pennsylvania;
H. J. Patterson, of Maryland;
H. J. Wheeler, of Rhode Island;
A. T. Neale, of Delaware.

Animal and Plant Breeding.

W. M. Hays, of Minnesota, *Chair.;*
C. F. Curtiss, of Iowa;
T. F. Hunt, of Ohio;
L. H. Bailey, of New York;
H. J. Webber, of Washington, D. C.

Collective College and Station Exhibit at St. Louis Exposition.

W. H. Jordan, of New York, *Chair.;*
H. J. Waters, of Missouri;
C. F. Curtiss, of Iowa;
W. M. Hays, of Minnesota;
T. F. Hunt, of Ohio;
A. C. True, of Washington, D. C.

LIST OF DELEGATES AND VISITORS IN ATTENDANCE.

Alabama: P. H. Mell, E. M. Wilcox, J. J. Wilmore.

Arkansas: R. L. Bennett.

Colorado: B. O. Aylesworth, J. H. Baker, L. G. Carpenter, Miss Jeannette Carpenter.

Connecticut: W. O. Atwater, W. E. Britton, Mrs. W. E. Britton, E. H. Jenkins, R. W. Stimson.

Delaware: W. H. Bishop, G. A. Harter, A. T. Neale.

Florida: T. H. Taliaferro.

Georgia: R. J. Redding, H. C. White.

Idaho: J. A. McLean.

Illinois: E. Davenport, C. G. Hopkins.

Indiana: H. A. Huston, C. S. Plumb, W. E. Stone, J. Swain.

Iowa: W. M. Beardshear, C. F. Curtiss, G. E. MacLean.

Kansas: E. R. Nichols, J. T. Willard.

Kentucky: F. P. Anderson, D. F. Frazee, J. K. Patterson, Mrs. J. K. Patterson. M. A. Scovell, Mrs. M. A. Scovell.

Maine: A. W. Harris, C. D. Woods, Mrs. C. D. Woods.

Maryland: H. B. McDonnell, J. B. S. Norton, H. J. Patterson, R. W. Silvester, W. T. L. Taliaferro.

Massachusetts: H. T. Fernald, H. H. Goodell, H. W. Tyler.

Michigan: T. F. Marston, C. D. Smith, J. L. Snyder.

Minnesota: W. M. Hays, W. M. Liggett, C. Northrop.

Mississippi: E. B. Ferris, J. C. Hardy, J. S. Moore.

Missouri: Miss M. Davis, R. H. Jesse, J. M. Stedman, H. J. Waters, Mrs. H. J. Waters, W. Williams.

Montana: J. Reid.

Nebraska: E. B. Andrews, E. A. Burnett.

New Hampshire: C. S. Murkland, F. W. Rane.

New Jersey: A. T. Jordan, J. B. Smith, E. B. Voorhees.

New York: W. Bengough, J. Craig, W. G. Johnson, W. H. Jordan, J. S. Meng, W. S. Myers, I. P. Roberts, M. V. Slingerland.

North Carolina: C. W. Burkett, B. W. Kilgore, F. L. Stevens, G. T. Winston, W. A. Withers.

North Dakota: C. B. Waldron, J. H. Worst.

Ohio: A. Cope, W. D. Gibbs, W. J. Green, A. D. Selby, W. O. Thompson, C. E. Thorne.

Oklahoma: D. R. Boyd, A. C. Scott.

Pennsylvania: H. P. Armsby, Mrs. H. P. Armsby, G. W. Atherton, W. Frear.

Porto Rico: F. D. Gardner.

Rhode Island: J. H. Washburn, H. J. Wheeler.

South Carolina: H. S. Hartzog, T. E. Miller.

South Dakota: G. Dropper, J. W. Heston.

Tennessee: C. W. Dabney, T. D. Morris, A. M. Soule.

Utah: J. T. Kingsbury.
Vermont: M. H. Buckham.
Virginia: W. B. Alwood, R. J. Davidson, J. L. Phillips, W. S. Sweetser.
Washington: E. A. Bryan, W. J. Spillman.
West Virginia: B. H. Hite, D. B. Purinton, J. H. Stewart.
Wyoming: A. Nelson, E. E. Smiley.
United States Department of Agriculture: A. C. True, E. W. Allen, E. Mead, W. H. Beal, D. J. Crosby, W. H. Evans, C. F. Langworthy, H. W. Lawson, D. W. May, J. I. Schulte, C. B. Smith, Miss M. T. Spethmann, and E. V. Wilcox, of the Office of Experiment Stations; H. E. Alvord, of the Bureau of Animal Industry; B. T. Galloway, A. F. Woods, C. R. Ball, E. A. Bessey, L. H. Dewey, D. Griffiths, R. E. B. McKenney, W. A. Orton, A. J. Pieters, G. H. Powell, F. Lamson-Scribner, C. S. Scofield, C. L. Shear, and H. J. Webber, of the Bureau of Plant Industry; C. C. Moore, of the Bureau of Chemistry; F. P. Veitch, of the Bureau of Soils; W. W. Cooke, of the Division of Biological Survey; Miss Josephine A. Clark, and Miss Claribel R. Barnett, of the Library.
Library of Congress: J. D. Thompson.
Bureau of Education: L. A. Kalbach.
Paris, France: Philippe de Vilmorin.
Tiflis City, Russia: N. P. Taratinoff.

PROCEEDINGS OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

MINUTES OF THE GENERAL SESSION.

Morning Session, Tuesday, November 12, 1901.

The convention was called to order at 9 a. m. in the Assembly Hall of Carroll Institute, President A. W. Harris, of Maine, in the chair.

On motion of G. W. Atherton, of Pennsylvania, a committee was appointed to wait on the President of the United States. The committee appointed by the president consisted of G. W. Atherton, of Pennsylvania; H. C. White, of Georgia; A. Cope, of Ohio; M. H. Buckham, of Vermont, and R. H. Jesse, of Missouri. Later the committee reported that it was very cordially received by the President, and had an opportunity to present to him briefly the purposes for which the Association had met, the points which it was deemed desirable for him to take into consideration as matters of public policy—the relations of institutions represented in the Association to the Government, etc. In response the President stated that although he was a graduate of one of the great universities founded upon another basis, he thought that the institutions represented in this Association were more nearly in accordance with the genius of the growing development of the American people than any other branch of higher education.

H. H. Goodell, of Massachusetts, on behalf of the executive committee, laid before the convention the following letters, which were read and ordered to be made a part of the proceedings:

Death of Justin S. Morrill.

Washington, D. C., *March 16, 1900.*

Prof. E. B. Voorhees,
New Brunswick, N. J.

Dear Sir: I regret exceedingly that a succession of unfortunate circumstances have prevented my acknowledging the receipt of the resolutions so finely expressed and beautifully engrossed, adopted by the American Association of Agriculturul Colleges and Experiment Stations, in memory of my beloved father, the late Senator Justin S. Morrill. They touched my heart deeply and always will be treasured and preserved by me, among other tributes to a great and good man's memory, as the most precious thing of my inheritance. My father had the greatest interest in the land-grant colleges and the grand work which they have accomplished made him very happy. Please allow me to convey through you to all the members of your Association my sincere thanks for and profound appreciation of the resolutions they passed and sent to me.

Very sincerely, yours,
James S. Morrill.

DEATH OF PROFESSOR MORROW.

PAXTON, ILL., *January 19, 1901.*

MR. EDWARD B. VOORHEES,
Secretary, New Brunswick, N. J.

MY DEAR SIR: I have received the resolutions adopted at your meeting of November 15, and on behalf of myself and children wish to extend to the Association my most sincere and hearty thanks and appreciation for the beautiful tribute to my husband's memory. We are glad that his character and labors warrant the very kind and complimentary things you say of him.

Very sincerely, (MRS.) GEORGE E. MORROW.

DEATH OF PRESIDENT SMART.

PURDUE UNIVERSITY, LAFAYETTE, IND., *January 23, 1901.*

E. B. VOORHEES,
Secretary and Treasurer, New Brunswick, N. J.

DEAR SIR: In behalf of Mrs. James H. Smart I beg to acknowledge the receipt of your favor of the 8th instant, accompanied by a copy of the resolutions adopted by the Association of American Agricultural Colleges and Experiment Stations, on the 15th of November, 1900.

Mrs. Smart wishes to thank the Association for their kind expression of esteem for her husband, and to assure you of her appreciation of your thoughtfulness in thus remembering her.

Yours, very truly, R. A. SMART.

DEATH OF SIR JOHN BENNET LAWES.

THE ROYAL SOCIETY, BURLINGTON HOUSE,
London, W., January 26, 1901.

DR. E. B. VOORHEES,
Secretary and Treasurer of the Association of
American Agricultural Colleges, New Brunswick, N. J.

SIR: I have to acknowledge receipt of an address of condolence from the Association of American Agricultural Colleges and Experiment Stations, touching the death of the late Sir John Bennet Lawes, the founder of this trust. The address shall be laid before my committee at their next meeting, and will be received by them, I am sure, with gratitude for the sympathy shown in the loss which they have sustained, and for the appreciation expressed of the life, character, and labors of their founder.

I am, sir, your obedient servant,

HERBERT RIX,
Secretary Lawes Agricultural Trust Committee.

THE ROYAL SOCIETY, BURLINGTON HOUSE,
London, W., February 16, 1901.

DR. E. B. VOORHEES,
Director Agricultural Experiment Stations,
New Brunswick, N. J., U. S. A.

MY DEAR SIR: The copy of resolutions adopted by the Association of American Agricultural Colleges and Experiment Stations at their meeting of November 15, 1900, receipt of which I have already acknowledged, was laid before the Lawes Agricultural Trust Committee at their meeting held yesterday, and I was instructed to acquaint you with the following resolution which was thereupon unanimously agreed to:

"*Resolved,* That this committee do highly appreciate the recognition accorded by the Association of American Agricultural Colleges and Experiment Stations to the labors of the late Sir John Bennet Lawes, on behalf of agriculture."

I am, dear sir, your obedient servant,

HERBERT RIX,
Secretary Lawes Trust Committee.

COMMUNICATION FROM PROFESSOR MANNING, OF DELAWARE COLLEGE, ON COMMERCIAL EDUCATION.

H. H. Goodell also laid before the convention the following communication from Professor Manning of the Delaware College; which was read and referred to the executive committee:

In view of the fact that the foreign commerce of the United States has vastly increased of late, the value of the exports from and the imports into the United States having been over two billions of dollars in 1900, and also that other countries, notably Great Britain, Germany, and France, are putting forth special efforts as our rivals in the world's markets, and that special commercial training of a high grade is needed by persons to become consuls, or to be representatives of our great and growing trade abroad, both in the products of the farm and factory, and in view also of the fact that the General Government now wisely gives aid to education in agriculture and the mechanic arts, we, the representatives (in Washington assembled this 12th day of November, 1901) of the colleges now receiving aid from the General Government, do suggest and urge that a further sum be set aside by Congress to be expended in furthering commercial education throughout the land, and that the same general regulations obtain as to the distribution of this sum among the several States as is now in force as to the sum devoted to agriculture and the mechanic arts.

The executive committee, through its chairman, subsequently reported on this matter as follows:

Your committee have considered this resolution, and while they deem the subject meritorious and their sympathies are more or less enlisted in the measure proposed, they feel that the time is inopportune for legislative action, and they commend this resolution to any committee that may have charge of legislative action.

The recommendation was agreed to.

REPORT OF TREASURER.

E. B. Voorhees, of New Jersey, submitted the treasurer's report, as follows:

Report of treasurer of the Association, November 13, 1900, to November 12, 1901.

RECEIPTS.

Amount on hand November 14, 1900	$112.97
Amount received from dues	1,020.00
Total	1,132.97

EXPENDITURES.

Committee on graduate study	$130.35	
Return dues overpaid	10.00	
Printing and manifolding	19.45	
Postage	7.00	
Engrossing resolutions	10.00	
Convention hall, Washington	25.00	
Executive committee	903.60	
Total		1,105.40
Balance in bank		27.57
Bills payable		86.38
In bank		27.57
Deficiency		58.81

An auditing committee consisting of W. M. Liggett, of Minnesota; J. L. Snyder, of Michigan; and E. Davenport, of Illinois, was appointed by the president, and later made the following report, which was agreed to:

> The auditing committee appointed to audit the accounts of the treasurer of this Association begs leave to report that it has compared the books and vouchers of the treasurer and found them to agree, and the said books and accounts appear to be correct.
>
> Respectfully submitted.
>
> W. M. Liggett.
> J. L. Snyder.
> E. Davenport.

Report of Bibliographer.

This report was submitted by A. C. True, of the Office of Experiment Stations, as follows:

> Increased attention is being given year by year to the preparation of bibliographies and reference lists. A thorough review of the literature of a subject is now recognized as an essential preliminary to further investigation of that subject. For this reason there has occurred during the past few years a rapid increase in the number of general bibliographies, and especially of reference lists or partial bibliographies of special subjects. Forty-four such bibliographies and reference lists are noted in this report.
>
> A large share of the work of the Office of Experiment Stations is of a strictly bibliographical character. Work on the card catalogue of foreign agricultural schools, experiment stations, and kindred institutions has been continued during the past year and a list of foreign experiment stations has been prepared and published as in previous years.[a] Work on bibliographies of bread and on the assimilation of nitrogen by plants has been continued, and a list of Russian dissertations and other papers on veterinary and related subjects has been prepared. The Office has also cooperated with the library in the preparation of a bibliography of irrigation, which has been submitted for publication. The librarian of the Department has placed in the hands of the printer a complete catalogue of the periodicals of the library.
>
> Bibliographies and reference lists relating to agriculture have been noted as follows:
>
> Arieti, G. I trattamenti preventi dei cereali contro la carie ed il carbone (On the preventive treatment of smuts of cereals). Le Stazioni Sperimentali Agrarie Italiane, 33 (1900), No. 5, pp. 405–429. An extended biblography of the literature of the subject is appended to a report on the treatment of grain for smut prevention.
>
> Bailey, L. H. The Principles of Vegetable Gardening. New York: Macmillan Co., 1901, pp. 458. Contains a list of 100 American books, 138 experiment station bulletins, and 14 publications by the various divisions of the United States Department of Agriculture on vegetable gardening.
>
> Banks, N. United States Department of Agriculture, Division of Entomology, Bibliography of the more important contributions to American economic entomology, VII, 1901, pp. 113. A list containing 1,383 titles of entomological articles which appeared during 1897–1899. A considerable proportion of the titles listed are newspaper articles.
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> Berlese, A. Entomologia applicata (Economic entomology). Rivista di Patologia Vegetale, 8 (1899), Nos. 1–6, pp. 190–192; 8 (1900), Nos. 7–12, pp. 193–202. A bibliography on economic entomology for the years 1898 to 1900, arranged alphabetically according to authors.
>
> ——— Gli acari agrari (Mites injurious to agriculture). Rivista di Patologia Vegetale, 8 (1899–1900), Nos. 7–12, pp. 295–297. A list of literature relating to injurious mites, from 1752 to 1897, inclusive.
>
> Berlese, A. N. Rassegne di lavori di patologia Vegetale (List of works on vegetable pathology). Rivista di Patologia Vegetale, 7 (1899), pp. 345–396. A list of contributions to economic entomology during the year, with brief abstracts of the more important papers.
>
> Bisson, E. Elenco di pubblicazioni attinenti alla bachicoltura, che vennero fuori nel corso del 1900 (Publications relating to sericulture during the year 1900). Annuario della R. Stazione Bacologica di Padova, 28 (1900), pp. 107–116. An extensive bibliography of the subject.

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[a] U. S. Dept. Agr., Office of Experiment Stations Buls. 59, 74, 88.

Blücher, H. Die Luft (The air). Leipzig: Otto Wigand, 1900, pp. XII+322. Contains numerous references to the literature of this subject.

Bolton, Henry Carrington. A Select Bibliography of Chemistry, 1492–1897, first supplement. It includes works omitted in the previous issue and brings the work down to the close of the year 1897. With a view to facilitating reference, the titles are grouped in six sections and arranged alphabetically by authors. Smithsonian miscellaneous collections, 39 (1899), No. 1170, pp. 489.

———. A Select Bibliography of Chemistry, 1492–1897; section 8, academic dissertations. Smithsonian miscellaneous collections, 1901, No. 1253, pp. 534. This is the third volume of the work begun by the writer in 1888. The entire work now contains more than 25,000 entries.

Briem, H. Die im Jahre 1900 in Fachzeitschriften, Broschüren, u. s. w., erschienenen Abhandlungen über die Zuckerrübe (List of publications on sugar-beet culture published in 1900). Blätter für Zuckerrübenbau, 8 (1901), No. 3, pp. 33–38. A bibliography of 149 publications bearing directly upon the culture of the sugar beet.

Clark, W. B., and Martin, G. C. Bibliography of Eocene Deposits. Maryland Geological Survey: Eocene. Baltimore: Johns Hopkins Press, 1901, pp. 31–43. A list of 113 references to literature relating to Eocene deposits (which contain marl beds) in Delaware, Maryland, and Virginia.

Conn, H. W. Agricultural Bacteriology. Philadelphia: Blackiston, 1901, pp. 412. Reference lists are given to the more important literature of the subjects discussed under the various headings.

Dietrich, F. Bibliographie der deutschen Zeitschriften-litteratur (Bibliography of German periodical literature). Leipzig: Felix Dietrich, 1900, Vols. V, pp. 353; VI, pp. 362. This is a subject and author index of original articles, mainly of a scientific character, published in German periodicals, pamphlets, and newspapers. Volume 5 includes the articles in 1,220 publications appearing from July to December, 1899, and volume 6 the articles in 1,365 publications appearing from January to June, 1900. A list of the publications is given in each volume.

Dock, Miss Mira L. Farmer's Library List. Pennsylvania Department of Agriculture Bulletin 65, p. 30. A selected list of publications of the U. S. Department of Agriculture and others are given. The titles are topically arranged, and cover agriculture and allied topics quite thoroughly.

——— Nature Study Reference Library. Pennsylvania Department of Agriculture Bulletin 64, p. 21. A topical list of reference works is given, based upon the judgment of a large number of teachers of nature study.

Duclert, L. Les éléments figurés du colostrum—Index bibliographique (The corpuscular substances of colostrum—bibliographical index). Annales de l'école nationale d'agriculture de Montpellier, n. ser., 1 (1901), No. 2, pp. 181–183. A list of 31 references to articles relating to investigations on this subject.

Estate Library [The]. (The Country Gentleman's Estate Book, 1901, pp. 261–273.) This is a selected and classified list of 312 books recommended as "suitable for a country gentleman's technical library." A similar list was given in the Estate Book for 1900, pp. 165–192.

Ganong, W. F. Plant Physiology. New York: Henry Holt & Co., 1901. Gives lists of references to the more important literature relating to the subject discussed in the different chapters.

Gerhardt, Paul. Handbuch des deutschen Dünenbaues (Handbook of German dune culture). Berlin: Paul Parey, 1900, pp. 656. Pages 629–644 of this work are devoted to a bibliography of the subject.

Griffon, E. Revue des travaux de physiologie et de chimie végétales, 1893–1900 (A review of works on plant physiology and chemistry, 1893–1900). Revue générals de botanique, 13 (1901), Nos. 147, pp. 137–144; 149, pp. 227–234; 150, pp. 276–284; 151, pp. 326–330; 152, pp. 364–368. Reviews are given of about 50 works relating to life, protoplasm, cells, etc.

Harrison, F. C. Foul Brood of Bees. Ontario Agricultural College Bulletin 112, pp. 30–32. A reference list of 81 entries.

——— The Ripening of Cheese and the Rôle of Micro-organisms in the Process. Transactions of the Canadian Institute, 7 (1901), I, No. 13, pp. 103–134. An extensive bibliographical review and a list of 29 titles of published works on this subject.

Hebebrand, A. Fortschritte der Agricultur-Chemie (Progress in agricultural chemistry). Chemiker-Zeitung, 24 (1900), Nos. 91, pp. 995–998; 93, pp. 1016–1018. A brief review of literature on the subjects of soils, fertilizers, and plant and animal production.

Hiltner, L. Ueber die Ursachen welche die Grösse, Zahl, Stellung und Wirkung der Wurzelknöllchen der Leguminosen bedingen (The causes which affect the size, number, position, and action of the root tubercles of Leguminosæ). Arbeiten aus der biologischen Abtheilung für Land- und Forstwirthschaft am Kaiserlichen Gesundheitsamte, 1 (1900), No. 2, pp. 177–222. A critical review is given of some of the more recent literature of the subject and a summary of the present status of knowledge regarding the functions, etc., of root tubercles.

Hunt, Clara Whitehill. An extensive bibliography of literature pertaining to nature study in primary schools. New York State Library Bulletin, Bibliography No. 16, January, 1899, pp. 465–491.

Lagatu, H. Revue bibliographique de chimie agricole; la décomposition des matières organiques dans la terre arable (Bibliographical review of agricultural chemistry; the decomposition of organic matter in cultivated soils). Annales de l'école nationale d'agriculture de Montpellier, n. ser., 1 (1901), No. 1, pp. 65–94. This is a review of investigations, with numerous references to literature, on the transformations which carbon and nitrogen compounds undergo in the soil, being especially complete as regards the process of nitrification.

Library of Congress. A union list of periodicals, transactions, and allied publications currently received in the principal libraries of the District of Columbia, Washington, 1901, p. 315. A preliminary list is given of these publications which will serve as a check-list and as a basis for a complete and correct list. About 10,000 periodicals are listed for the 16 libraries, the Department of Agriculture library containing more than 2,000.

Malpeaux, L. La betterave à sucre (The sugar beet). Paris: Masson et cie, pp. 206. A list of 32 references on the sugar beet, including books and articles consulted by the author, is given.

Mayer, Paul. Zoologischer Jahresbericht für 1900 (Zoological Yearbook for 1900). Berlin: R. Friedländer & Son, 1901, pp. 488. Detailed lists of literature relating to all the various groups of animals. The more important publications under each group are briefly abstracted.

Miller, M. F. The Evolution of Reaping Machines. U. S. Department of Agriculture, Office of Experiment Stations Bulletin 103, pp. 42, 43. A list of 50 references to literature of the subject.

Munson, W. M. The Horticultural Status of the Genus Vaccinium. Maine Station Bulletin 76, pp. 156–158. A list of authors and references to 44 papers on huckleberries and cranberries.

Pammel, L. H., and Hodson, E. R. Asparagus Rust, Iowa Bulletin 53, pp. 66, 67. A brief bibliography is appended to a bulletin on the nature, distribution, and treatment of asparagus rust.

Passy, Louis. Notice bibliographique sur les principaux ouvrages relatifs a l'agriculture et aux sciences agricoles publiés en France pendant l'année 1900 (A bibliography of the principal works relating to agriculture and the agricultural sciences published in France during the year 1900). Bulletin des séances de la société nationale d'agriculture de France, 60 (1900), No. 12, pp. 816–859.

Phillips, W. F. R. Recent Papers bearing on Meteorology. Lists published each month by the Monthly Weather Review.

Pierce, N. B. Peach Leaf Curl. U. S. Department of Agriculture, Division of Vegetable Physiology and Pathology Bulletin 20. Numerous references are given to publications relating to this disease.

Ramsey, A. Bibliography of Bacteria. The Scientific Roll and Magazine of Systematized Notes, Vol. I, Nos. 1–3, pp. 96. Gives an extensive bibliography of bacterial literature from 1680 to and including part of 1901. More than 3,000 titles are listed.

Rothschild, H. De. Bibliographia Lactaria (Bibliography of Milk). Paris: Octave Doin, 1901, pp. 584. This is a general bibliography of the subject of milk and its products, containing 8,375 titles and covering a period from the beginning of the sixteenth century to the close of 1899. Titles are arranged by subjects, with entries in chronological order under each subject. An author index and a list of inventions and patents are also given.

——— Bibliographia Lactaria, premier supplément, 1900 (Bibliography of milk, first supplement, 1900). Paris: Octave Doin, 1901, pp. 98. This contains a list of 1,324 works which have appeared since 1899.

Salmon, E. S. Monograph of the Erysipheæ. Memoirs of the Torrey Botanical Club, 9 (1901), pp. 1–292. Gives an extensive list of the literature relating to the powdery mildews.

SCHÜTZ, ERNST. Untersuchung der säurefesten Pilze zur Förderung der Molkereiwirtschaft (Investigation of the acid-resistant micro-organisms in the improvement of the dairy industry). Landwirtschaftliche Jahrbücher, 30 (1901), Nos. 1–2, pp. 223–257. The literature of the subject is reviewed at length and a bibliography of 24 references appended.

SCRIBNER, F. LAMSON. Bibliography of American Grasses. U. S. Department of Agriculture, Division of Agrostology Bulletin 20, pp. 171–193. An alphabetical list is given of all the works cited in the author's illustrated work on American Grasses. More than 300 articles are cited.

SHAW, ROBERT KENDALL. An Extended Bibliography of the Literature on Domestic Economy printed in English between 1850 and 1899, inclusive. One of the sections refers to food, cooking, etc. New York State Library Bulletin 52, Bibliography 22, January, 1901, pp. 31–170.

SLINGERLAND, MARK VERNON. Brief Bibliography of the Palmer Worm. New York Cornell Station Bulletin 187, pp. 99, 100.

STURGIS, W. C. A Provisional Bibliography of the More Important Works published by the U. S. Department of Agriculture and the Agricultural Experiment Stations from 1887 to 1900, inclusive, on Fungus and Bacterial diseases. Connecticut State Station Report 1900, III, pp. 255–297. This is designed for the practical observer of plant diseases to enable him to ascertain the principal sources of information regarding the cause and prevention of various diseases.

TASCHENBERG, O. Bibliotheca Zoologica II. Verzeichniss der Schriften über Zoologie welche in den periodischen Werken enthalten und vom Jahre 1861–1880 selbstständig erschienen sind (Publications on zoology which appeared in periodicals and independent volumes from 1861 to 1880). Leipzig: Wilhelm Englemann, 1901, pp. 4529–4844. This part of the work contains a list of literature published between 1861 and 1880 on mammals. One section is devoted to paleontological literature of mammals.

TOLLENS, B. Ash Constituents of Plants. Experiment Station Record, 13, pp. 27. A review of this subject containing numerous references to literature.

TOUMEY, J. W. Crown gall. Arizona Bulletin 33. Refers to much of the American and considerable foreign literature relating to the occurrence, distribution, and assigned causes of crown Gall or crown knot.

TUTT, G. W. British Lepidoptera. London: Swan Sonnenschein & Co., 1899, Vol. I, pp. 560; 1900, Vol. II, pp. VIII + 584. Throughout the two volumes of this work are found extensive bibliographies of the special subjects considered.

WILCOX, E. M. A Rhizomorphic Root Rot of Fruit Trees. Oklahoma Station Bulletin 49. Lists 133 memoirs, etc., which treat of diseases of trees caused by the higher fungi.

REPORT OF THE EXECUTIVE COMMITTEE.

The following report was submitted by H. H. Goodell, chairman of the executive committee:

Immediately following adjournment of the last convention the new executive committee met and organized for the year, making choice of E. B. Voorhees for secretary and H. H. Goodell for chairman.

To the nine measures referred to it for consideration careful attention has been paid and such action taken as the circumstances in each case seemed to warrant. First in importance was the bill for the establishment of schools or departments of mining and metallurgy in connection with the colleges for the benefit of agriculture and the mechanic arts. It will doubtless be remembered that during the last session of Congress (Fifty-sixth Congress, first session) the Senate Committee on Mines and Mining reported a bill (S. 3982) entitled "A bill to apply a portion of the proceeds of the sale of the public lands to the endowment, support, and maintenance of schools or departments of mining and metallurgy in the several States and Territories in connection with the colleges for the benefit of agriculture and the mechanic arts, established in accordance with the provisions of an act of Congress approved July 2, 1862."

The committee gave a very careful and detailed consideration to all the provisions of the bill, and unanimously reported it to the Senate with a favorable recommendation, accompanying it with a report (No. 994) which fully set forth the merits of the measure and the great national importance of the interests it was intended to promote.

The Senate, in turn, subjected the bill to a searching and thorough discussion, adopted a few useful amendments, and passed it without a dissenting vote.

When the bill reached the House of Representatives it was referred to the Committee on Mines and Mining, was there fully considered and unanimously reported to the House, with a favorable recommendation, as a substitute for one that had been previously reported from the same committee and was then on the House Calendar. The bill was reported by Mr. Mondell, of Wyoming, who had given particular attention to the subject and who accompanied it with a strong and convincing report (No. 1631).

Thus the measure stood when Congress adjourned, the pressure of other business preventing this from reaching a vote. The bill as it stood was in the nature of a compromise, and is believed to be just and acceptable to all interests. Several bills relating to the same subject-matter have been before each committee, and the form finally agreed upon seems to embody the best features of all. Your committee recommends that this bill or one of similar import be introduced at the earliest practical moment of the next session of Congress.

Under the resolution that the executive committee take into consideration the matter of making the collective exhibit of the stations a permanent exhibit of the experiment stations at the national capital and endeavor to make suitable arrangements for its permanent installation and care at Washington, a communication was sent to the honorable Secretary of Agriculture, stating the wish of the Association, and asking whether such installation and care were feasible. The following reply was received: "The exhibit is now at Buffalo, and very likely will be used at Charleston next winter. The question of its permanent installation here will be carefully considered when we are through with its use at these expositions."

In the closing hours of the last convention a communication was received from the management of the Pan-American Exposition asking that a delegate be appointed to the dairy test to be held in Buffalo. The executive committee was directed to appoint the delegate. At a meeting held later Director W. H. Jordan was so appointed.

Conformably to resolution offered by Dr. Dabney, a memorial was sent to the honorable Secretary of Agriculture indorsing his action in opening the Department of Agriculture to the graduates of the colleges established for the benefit of agriculture and the mechanic arts and pledging the earnest support of the Association in carrying out that policy.

The executive committee was further directed to urge upon the honorable Secretary of Agriculture the desirability of publishing:

(*a*) A second edition of the history and description of experiment stations as originally prepared for the Paris Exposition.

(*b*) A separate edition of the addresses of President Atherton and Director Jordan.

(*c*) The lectures of Dr. Bernard Dyer.

The second edition of the history of the experiment stations in this country has already been published and distributed. The lectures of Dr. Dyer have been approved and will shortly be issued, but in regard to the addresses of President Atherton and Director Jordan it was thought wiser to publish separates from the account of the proceedings of the convention than to ask for a separate edition.

The question of constituting all land-grant colleges designated depositories of Government publications has continued through the past year to claim the attention of your committee. Taking advantage of the fact that a bill to amend the act regulating the public printing and distribution of public documents was then being considered, it succeeded in having an additional section incorporated, including all the colleges among the number of designated depositories. The bill, however, failed of being called up, and the section shared the fate of the bill, dying with the last Congress. It seems unwise to introduce this into Congress as a special bill, and it is recommended that the new executive committee keep in touch with the printing committee and see that a section providing for our interests is inserted in the amended bill.

The executive committee has considered the summer school of graduate instruction in agriculture, suggested by the Ohio State University, and the offer of the university to assume responsibility for the expenses of the first session. The committee recommends that the convention approve the holding of a session during the summer of 1902, to be under the control of the president of the said university, with the expectation of adopting the school as a cooperative enterprise under the control of the convention should the success of the first session seem to justify the continuance of the school. The following outline is submitted as a basis for the discussion of the convention:

(1) A summer school of graduate instruction in agriculture shall be conducted under the auspices of the American Association of Agricultural Colleges and Experiment Stations, the sessions to be held at different institutions belonging to the Association, as the convention from time to time may direct.

(2) Each convention shall appoint a committee of control, to be composed of three

members, one of whom shall be the president of the institution at which the next session is held, or some other representative selected by that institution.

(3) The committee of control shall have power to select the director and other officers of the school and to fix their duties and compensation.

(4) The convention shall provide, either by itself or in cooperation with the institution at which the session is to be held, for the expenses of the school, and for this purpose a special annual assessment, not to exceed $10, may be laid upon the colleges and experiment stations belonging to the Association.

For the executive committee:

H. H. GOODELL, *Chairman.*

After lying on the table for a day to permit the consideration of certain of the questions raised by the report, it was accepted.

REPORT OF SECTION ON ENTOMOLOGY.

M. V. Slingerland of New York, submitted the following report:

In 1887, in perhaps ten or a dozen of the agricultural colleges, more or less instruction was being given in entomology. With the establishment of the experiment stations in 1888, 20 States arranged to use 25 entomologists and a few horticulturists and botanists in the college and station insect work. At the fourth convention of this association in Champaign, Ill., in 1890, the entomological section held its first meeting, and by that time 35 entomologists were at work in 28 States, and a half dozen other States were doing some work with insects. About 40 entomological bulletins were published in 1890. Ten years later, in 1900, about 70 entomologists were employed by the colleges and experiment stations and more or less entomological work was being done at nearly every one of the 57 experiment stations in the United States. Thus the entomologists have doubled in numbers during the past decade, and in 1900 about 60 bulletins resulted from their work. We doubt if any other branch of station or college work can show a greater increase in workers; we nearly equal in numbers the horticulturists or the botanists. In 1888 the first insectary in the world was built at the Cornell Experiment Station for the study of insect problems. In 1891 three stations had insectaries, and now there are a dozen or more.

Usually the entomologist serves both in the college and station, often with an assistant. In New York seven entomologists are employed in teaching and investigating, four doing mostly station work; and there is also a State entomologist and one or two assistants. In several States the horticulturist or botanist does considerable insect work, but in such great States as Pennsylvania, Wisconsin, Tennessee, Indiana, and Alabama practically no important entomological investigations are being made.

The advent of the San José scale into the East has resulted in the appointment of State entomologists in many States, and usually the station entomologist is appointed. As this is primarily an insect question, it should be in the hands of a reputable entomologist and not be turned over to a commissioner or board of agriculture and often untrained assistants.

With such inspection or police duties, more or less teaching, an ever increasing correspondence, farmers' institute work, and other necessary official duties, it is a wonder that many of the entomologists find any time for investigational work, and yet much good work is being done every year. But a careful survey of the published results reveals the fact that more original work is coming from those who have little college and State inspection work. This result is inevitable, for good investigational work requires constant observation, attention to details, and unlimited, unhampered time. No day is long enough for a man to inspect nurseries, attend farmers' institutes, teach several hours, write five to a dozen letters, eat and sleep, and then attempt a careful study of some destructive insect. Some of this work, which no entomologist ought to shirk, must be left half done, and unfortunately it is too often that the original investigation suffers. There is never any lack of insect problems to investigate; old pests, like the codling moth, need to be studied in the varying conditions in different States, and old and forgotten pests, like the palmer worm, may appear after a long period of obscurity, or unknown insects, like the cherry fruit-fly, may suddenly appear in injurious numbers, and in all of these instances prompt and careful investigations are needed. We would not have the entomologist solely an investigator, for a little teaching in the college will keep him in touch with the educational world, and such work will arrange and systematize his knowledge. And, again, he should attend some of the farmers' institutes, for there is no better place to come in touch with the practical phases of his work. The correspondence also, while sometimes a drudgery, is often the most important part of the entomologist's work, for he can many times come in touch with an intelligent and needy sufferer from an insect pest and be able to give immediate relief by his advice.

If the proposed changes are made in the constitution of this association, it will eliminate the entomological section and will also largely prevent the representation at the conventions of one of the largest corps of college and station workers, for few, if any, of the entomologists will then be sent as delegates. We believe this to be an unwise policy. The directors of the stations and the presidents of the colleges should feel it their duty to attend, but the investigators and teachers should also be sent, for nothing will stimulate and encourage them more than to see and to meet with such a distinguished body and to discuss their special problems with other workers in their line. The entomologists send an almost unanimous protest against the elimination of their section. True, the section has had a rather precarious existence. The section has met eleven times, and only the first (in 1890) and the last (in 1900) meetings have been thoroughly successful; at only two other meetings (the sixth, in Denver in 1895, and the seventh, at Washington in 1896) have the required number of six papers been submitted, and so far as the records show there has been practically no formal meeting of the section at five or six conventions. The number of entomological delegates has varied from two to about a dozen, but over twenty have attended some of the meetings of the section. There are some good reasons for this rather poor showing.

First. The fact that until last year practically none of the papers presented in our section was ever printed in full, and only once were they briefly abstracted in the proceedings of the convention, while many of the papers in some of the other sections were frequently published. No one likes to prepare a paper to be read by title only, or perhaps not at all, and then have to get it published elsewhere. We believe this has been the most discouraging feature with which the officers of the entomological section have had to contend in trying to get up a programme. Assure the publication of our papers in the proceedings, as was done in last year's report, and we believe the entomological section will prove a successful and helpful element in the deliberations of this Association. It will stimulate the entomologists to assert their right to a fair representation among the delegates, and thus insure the success of the section.

Second. Many have suggested that a prime cause for the apparent lack of interest in the entomological section was the fact that the same class of subjects is discussed in the section as is presented to the very successful Association of Economic Entomologists, which meets with the great American Association for the Advancement of Science. The prompt publication of the proceedings of this entomological association and the chance it affords to meet so many more workers in the same field has undoubtedly led entomologists to prefer to attend and contribute to its success and to lose interest in the entomological section of this convention. We think it would be wise to confine our discussions in the entomological section, so far as possible, to specified subjects of college or station work, as was admirably done last year, and not present a miscellaneous programme.

Publish our papers, which we will try to confine to more specific phases of our work, and thus stimulate and encourage us to attend the conventions, and the entomologists will make their section a successful and helpful adjunct to this great body of workers. We believe that the entomological workers in the agricultural colleges and experiment stations are doing as much to build up these institutions through a voluminous correspondence, through their publications, through their class-room work, through the far-reaching nature-study movement, and in other ways as are any other group of workers in allied subjects. Therefore encourage us rather than eliminate us.

M. V. Slingerland, *Chairman.*

The report was accepted.

Inspection of Land-grant Colleges.

The chairman laid before the convention the following resolution, introduced by E. A. Bryan, of Washington, at the last meeting of the Association:

> Whereas the experiment stations have profited greatly by the annual visits of a representative of the Office of Experiment Stations, such visits not only unifying the efforts of the stations, but improving the spirit and method of research and being conducive to a more satisfactory expenditure of funds; and
>
> Whereas a like visit to the colleges by the Commissioner of Education or his representative would tend to strengthen and unify the land-grant colleges: Therefore be it
>
> *Resolved*, That the executive committee of this Association be directed to consider the expediency of inviting the Secretary of the Interior to make such recommendation to Congress as would result in the annual inspection of the land-grant colleges by the Bureau of Education.

E. A. Bryan. I move the adoption of this resolution. I did not know that it would come up at this time; but offered the resolution because it seemed to me that its adoption would be very desirable. There has been too little solidarity among the land-grant colleges. There has been too little uniformity in the curriculum and in the methods of study. It has seemed to me that a system of visitation or inspection of the land-grant colleges by some officer of the Bureau of Education would certainly be very desirable in promoting such uniformity. I do not know that the examination with reference to the expenditure of funds is the most important matter connected with this proposition, but perhaps it is quite as important as examination with reference to the expenditures of the experiment stations. Twenty-five thousand dollars a year at least come to these institutions under the Morrill Act of 1890, and $15,000 a year under the Hatch Act. It would seem to be just as desirable that the expenditure of the funds under the Morrill Act should be examined as that the expenditure of funds under the Hatch Act should be looked into.

This resolution, however, does not look so much to that end as to promoting the solidarity of the institutions and securing uniformity in the courses of instruction in our Federal colleges.

C. W. Dabney, of Tennessee. I would like to hear this resolution further discussed. I do not propose to say anything in opposition to it; I simply wish to suggest that there is another side to this question which ought to be considered. We are all familiar with the law with reference to our land-grant colleges. We recall that clause which provides that the States shall have something to say about the course of study. I think the language of the law provides that the subjects to be taught in these colleges shall be such as the States shall direct. That provision of the law is very wise. American agriculture is greatly diversified. We have a country of marvelous resources, capable of producing, in one portion of it or another, almost every product known to the world. No two States are alike in agricultural resources. The result is that these colleges have a very varied work. It would seem to be practically impossible to lay out a course of instruction adapted to the conditions of all the States, even in respect to the elements of agriculture and agricultural science. Our public-school systems in the different States vary greatly in their aims and purposes. The preparatory education that obtains in these schools is very varied; therefore the courses in the colleges must vary very greatly. On a hasty view, I can not see how any such thing as uniform courses can be adopted. I can see that a great deal of good would come from proper inspection by broad-minded inspectors, but we may not always have such broad-minded inspectors as would be desirable in the interests of these colleges. If it is proposed by anyone to give to the Bureau of Education anything like the right to dictate to our colleges what they shall teach and how they shall teach it, the proposition is too absurd for debate.

I simply make these remarks to impress upon the convention the idea that we ought to consider this resolution very carefully before we adopt it. I do not think it is a proposition to be adopted offhand and without very careful investigation and thorough discussion.

I should not have risen to address the convention on the subject had it not seemed to me that the resolution was about to be acted upon one way or the other without debate.

E. A. Bryan. Mr. President, I call attention to the fact that this resolution simply asks the executive committee of this Association to consider the expediency of the movement proposed. The relation between the Bureau of Education and the land-grant colleges has heretofore been a very slight one. Very little attention has been given by that Bureau to these institutions as such. It has seemed to me that good would result from a closer relation in promoting greater uniformity in the methods and purposes of the land-grant colleges.

There is no denying the fact that there is a great diversity in the views held by men engaged in these institutions. I believe it might be advantageous for these colleges occasionally to have a visit from a wise and intelligent man, looking over the whole field, giving counsel here and there for the betterment of the work.

I would be loath indeed to see any movement inaugurated which would lead to improper interference on the part of the Department of the Interior with the land-grant colleges of the several States; but I do not think any such thing is involved in this resolution.

W. A. HENRY, of Wisconsin. Mr. President, I think that such an inspection as is here proposed might accomplish much good. All of us are called upon to prepare certain statistics for the use of the Commissioner of Education in his annual report. The questions propounded to our institutions do not, as I know, always fit us at all. I wonder if the same difficulty is not experienced in some other institution? Perhaps ours is unique. Now, if an inspector from Washington were to visit the institutions in the various States and post himself on the educational conditions of those institutions, I believe that the questions sent out from the Bureau of Education would be more comprehensive, more useful, and would call for information in many cases more obtainable by us who are to make out the responses. Anyone who has been called upon to make out these reports knows how difficult it is to furnish some of the information asked for, and how the information furnished seems in some places to cross itself, as if someone here in Washington were not in close relations with the institutions about which he propounds inquiries. I believe that a central authority to conduct this work of inspection could do a great deal of good.

C. S. MURKLAND, of New Hampshire (calling attention to the language of the preamble of the resolution). It seems to me that, in view of the action here proposed, it would be the wiser course to adopt the resolution without the preamble. The resolution itself is perfectly clear and explicit; the preamble is obscure and confusing. I suggest that before the resolution is passed upon by the association the preamble be struck out.

On motion of President Murkland this action was taken.

W. O. THOMPSON, of Ohio. Mr. President, it seems to me that this resolution assumes a relationship as existing between the land-grant colleges and the national Bureau of Education which does not in fact exist. I have in my mind at this moment our commissioner of public schools in the State of Ohio. That officer of course is supposed to have some relation to the general educational system as an incident to his work. He does in fact collect certain statistics from the colleges. Now the United States Commissioner of Education, while he does attend the meetings of the educational associations has very little, if any, relation to the land-grant colleges of this country. The work which he does concerning statistics seems to be a subordinate incident of his duties. It seems to me that until the work of the Commissioner of Education is so changed or enlarged that it shall have some relation to the land-grant colleges of the country, this resolution is premature.

As a matter of fact the Commissioner of Education knows but little about this association officially; and he may care just as little. I do not speak personally of Commissioner Harris, for whom I have the highest regard; still I say that his relation to this association is a very distant one, and a very distant one to every one of our colleges in the country. I am disposed to think that this gathering of statistics is largely for the purpose of making a statistical view of higher education in the United States, in response to a popular demand, rather than in response to any demand for higher educational institutions themselves. It seems to me that the action proposed would impose upon the Educational Bureau of the United States new duties and responsibilities which, as I understand, have not been provided for or contemplated by the existing law.

A delegate stated in reply to a question that prior to the drawing of warrants for the payment of money under the Morrill Act to the land-grant colleges, the Commissioner of Education is required to see, to the best of his knowledge and belief, that the various colleges and experiment stations are performing the work required of them by the Morrill Act; and upon receiving such information from the Commissioner of Education the Secretary of the Interior draws his requisition upon the Secretary of the Treasury, and thereupon the check is made out; so that the Commissioner of Education is supposed to keep himself informed as to the work going on in the several States under the Morrill Act.

A DELEGATE. Mr. President, it occurs to me that there is one question which has not been, but ought to be, answered in connection with this subject. That question, about which there is a great deal of confusion on this floor, is whether this proposed investigation is for the good of the colleges or the good of the Department. If for the good of the Department, well; if for the good of the colleges, why should the Department of Education rather than the Department of Agriculture make this inspection?

E. B. ANDREWS, of Nebraska. Mr. President, I think I may say that the present Commissioner of Education (though I have no authority to speak for him) is deeply interested in the work of this Association. With his large mind, I think he would favor the resolution now before the convention. But a man of much less information and much narrower sympathies might come into that office; and the inspection of such a man might not do us any good. I am inclined to think that the forces now at work for the unification of education in this great country, where there is so great a variety of conditions prevailing, are, to say the least, sufficiently strong. I am therefore inclined to think that the adoption of this motion would not be exactly judicious—at least at the present time. I move, therefore, that the resolution (with all respect to the gentleman from whom it emanates), be laid on the table.

The question being taken, the motion to lay the resolution on the table was agreed to.

At this point in the proceedings M. Philippe de Vilmorin, of Paris, France, was, on motion of H. H. Goodell, seconded by C. W. Dabney, given the privileges of the floor and spoke briefly of his interest in the progress of agricultural science in America, and his admiration for the work that is being done in this line by the various agricultural institutions of the country.

INDEXING AGRICULTURAL LITERATURE.

A. C. True, of the Office of Experiment Stations, reported as follows for the standing committee on indexing agricultural literature:

During the past year the committee on indexing agricultural literature, in cooperation with the Library of the Department of Agriculture, has continued its efforts to promote work in the line for which it was appointed. Owing to lack of funds it has not been feasible for the Department Library to undertake the indexing of agricultural periodicals and books, and much progress in this direction can not be expected until that library has larger financial resources.

It is estimated that to put this work on a good footing would require an increase of about $2,500 in the current income of the library. If it is desired to have this work taken up and prosecuted vigorously, we must in some way secure an increase of funds by at least that amount annually.

The Librarian of the Department, Miss J. A. Clark, who is a member of this committee, has, at the request of the committee, prepared a brief statement regarding the work of agricultural college libraries, in connection with which she will refer to the progress which the Department has made in indexing agricultural literature.

With your permission I will introduce Miss Clark to read her paper, which completes the report.

Miss Clark read the following papers:

AGRICULTURAL COLLEGE LIBRARIES.

It is rather the exception to find the library of the agricultural college made an important factor in the administration of the college. The library, although the right hand in all study and investigation, is the last to receive its due support and the first to suffer when a reduction in expenditures must be made. The case of the library, of whatever kind, when dependent upon State or municipal support, is quite similar to that of the public schools. When appropriations diminish, these two institutions are almost always the first to feel the effects of retrenchment. It takes a weary while to learn the extravagance of this kind of adjustment to make ends meet. The most charitable view to be taken of these not infrequent enactments is, that the relative importance of the library, in the case of the agricultural college, is not appreciated by a sufficiently large number on the governing board to bring about the desired standard of efficiency. I venture to assert that a book may be as important as any farm implement in bringing to harvest an abundant crop. Certain classes of books are tools, and should be so considered, in connection with agricultural education and investigation, and not only as tools, but as indispensable ones. The great importance and even necessity of a well-selected collection of books on agriculture, horticulture, and the kindred sciences for professors and students, are conditions readily granted by all; but the equal necessity of a systematic arrangement and complete catalogue of the same does not find equally favorable recognition. From observation and from report I find the agricultural college libraries variously organized, and unorganized, adjuncts of the institutions to which they belong, this state of affairs resulting from a lack of interest, or a lack of means, or both, to better the condition. Of the six libraries I have recently visited, but two can be said to be thoroughly well organized and administered, as well as to have excellent collections of books; two others are well-selected libraries, but lose much in efficiency from inconvenient arrangement and incomplete cataloguing. In granting that a library is a necessary part of the equipment of every agricultural college, and that it must add hundreds, if not thousands, of publications to its shelves annually to further the work of the professors and students, it becomes a duty as well as a necessity to preserve the collection and make it available.

The old idea of the functions of a library and of a librarian is quite changed. The librarian has become a vital factor in modern education. It would be an extravagant expenditure to employ a person to simply guard books in a certain room called a library, for such a person is but a keeper of books and the place a storeroom.

Real economy of time and money lies in the direction of placing the library on a footing with the other departments of the college and in charge of a person especially trained for the work. With such provisions a great deal of the time of professors and students is saved in reference work, and, to the latter especially, aid is given in the use of a library which would otherwise be gained by long experience. If the college curriculum should include a course of lectures by the librarian as to how to use the library, calling attention to its resources and to its special bibliographical aids in study and research, the benefits would be apparent. Such instruction is being given in many of our universities and colleges, but I do not know of similar instruction in agricultural colleges. A trained librarian would also build up the library largely by obtaining many valuable publications by gift and by exchange. I almost venture to say that there are very few agricultural colleges which have anything approaching a complete set of the publications of the Department of Agriculture, of the experiment stations, of the State boards of agriculture, or of the State boards of horticulture. These alone would make a most respectable working library for students of agriculture, and these are to be had for the asking, but there must be some one person whose business it is to do that asking and to make the most of the receipts. There are other opportunities to acquire really valuable material for these libraries by one familiar with the needs and with the opportunities of meeting them. A miscellaneous collection of books is not necessarily a library, and may, indeed, be far from a working library. The element of selection must enter into the account, and the earlier in the history of a library judgment and experience are engaged in the work the happier will be the results. After a good collection of books is acquired, then often there are no funds to arrange and to make it available by catalogues, reference lists, and the like; but the longer this work is put off the greater the expense. If it were remembered that a small library well catalogued is of more service than a large one with no catalogue, or with an indifferent one, at best, perhaps a part of the funds might be diverted at intervals from the purchase of books to revealing their contents.

Arrangements are in prospect of fulfillment by means of which there may be a number of assistants at the library of the Department of Agriculture, who shall be preparing for such work as I have outlined as necessary in agricultural college libraries. The Department library contains the largest collection of publications on agriculture in the country, and in the allied sciences its collections rank among the highest. It therefore offers exceptional facilities to prospective librarians of agricultural colleges who wish to become familiar with the literature of agriculture. The request has already come to the Department from one agricultural college for such an assistant, and it has been met in an exceptional way. One of the assistants who has catalogued a large part of the Department library, and is familiar with agricultural publications, has been detailed to classify and catalogue this college library and introduce modern methods of administration. This is an experiment, the result of which remains to be seen. Another request has been more recently made by an assistant in an agricultural college library to be permitted to spend her winter vacation in the Department library for the purpose of studying its collections and their arrangements. This is a step in the right direction, as it will tend to bring about a closer relationship between the college libraries and the Department library which seems desirable.

In connection with library work and as a member of the committee on indexing agricultural literature, I have been asked to report on what has been done in that direction the past year. As far as I know all the published indexes of agricultural literature have been issued by the Department of Agriculture. The Office of Experiment Stations has continued the valuable card index of experiment station literature, the number of cards issued the past year being 1,900, making a total of 21,500 cards published up to date. This Office has also completed a card index of the first twelve volumes of the Experiment Station Record, which it intends to publish in book form as soon as funds will permit.

An index to literature relating to animal industry in the publications of the Department of Agriculture, 1837 to 1898, prepared by Mr. Geo. F. Thompson, of the Bureau of Animal Industry, has proved a most useful addition to our published indexes. The volume contains 676 pages, furnishing about 75,000 references to the publications mentioned. The Library of the Department has continued the printing of the card index to the Department publications, issuing the cards as fast as the printing appropriation would allow. The index now includes the Yearbooks up to 1900, and the Farmers' Bulletins up to 118; an issue is nearly ready for distribution which includes Farmers' Bulletins 119–128, and the publications of the following divisions: Accounts, Agrostology, Botany, and Soils. Reports are constantly coming to us of the usefulness of these cards in revealing the valuable material long buried for lack of an index which could be incorporated with the general catalogue of the library. Few indeed are the libraries which have the wherewithal to care for their collections of Government documents as they do for other accessions which are in greater demand. Therefore all aids which make these documents available are greatly appreciated. A beginning has thus been made in the indexing of agricultural literature, and where it should properly begin. The field is extensive, and progress should be made more rapidly in the work to save the time of present and future investigators.

If facilities for editing and printing the material could be assured at the Department of Agriculture, there would probably be more uniformity in the results attained, and the cost would be nominal. As the Library of Congress has undertaken to supply printed catalogue cards at cost price to all libraries which desire them, so it seems entirely feasible for the Department of Agriculture Library to further, by cooperation or otherwise, an undertaking of small magnitude compared with that of the Library of Congress, namely, the indexing of the literature of agriculture.

The report was accepted.

H. P. Armsby, of Pennsylvania, introduced the following resolution, which was referred to the executive committee:

Resolved, That the executive committee be instructed to use their best efforts to aid in securing more means to be used by the Department of Agriculture in indexing agricultural literature.

The executive committee subsequently recommended the adoption of this resolution, and the recommendation was agreed to.

UNIFORM FERTILIZER LAWS.

H. J. Wheeler, of Rhode Island, read the following report of the standing committee on this subject:

Since the last meeting of the Association, your committee, in cooperation with a similar committee of the Association of Official Agricultural Chemists, has arranged for the printing, on the part of the Department of Agriculture, of additional copies of the report adopted by both associations setting forth the points in relation to which uniformity is desired. Copies of this report have been distributed, and an effort has been made to have existing laws, when modified, changed in accordance with the recommendations; also to influence new legislation in States where fertilizer laws have not heretofore existed. To this end the matter was brought to the attention of the United States Commission on Uniformity in Legislation during its last session at Denver, Colo., and your committee is unofficially informed that the commission voted to authorize the individual members to cooperate with the members of this Association, and of the Association of Official Agricultural Chemists in their respective States, for the purpose of securing the desired uniformity in fertilizer laws whenever it shall be deemed wise or judicious to further amend the same.

Your committee respectfully urge the members of this Association to bear this matter in mind and to use their utmost endeavors to secure the end desired.

Respectfully submitted on behalf the committee.

H. J. Wheeler, *Chairman.*

The report was accepted.

Investigation and Instruction by Station Officers.

On motion of W. A. Henry, of Wisconsin, the following resolution, offered at the last convention, was taken up:

Resolved, That it is the judgment of this Association that the director and the heads of divisions of station work should, if possible, devote their whole time to the work of investigation. If this is impossible, then it is essential to good work that such heads of divisions shall spend their best efforts in the station work and act secondarily as teachers in a limited way. If there is to be a combination of investigation and instruction, then the investigator shall direct this instruction, and not the instructor direct the investigation.

W. A. Henry, of Wisconsin. Mr. President, as the mover of this resolution, I wish to call attention to the fact that a part of the income of our colleges and experiment stations is made up of $15,000 received each year from the United States Government; there is also in many cases additional money turned over to the college or university for purposes of investigation. The point I wish to make is that the United States Government has given over three-quarters of a million dollars to various States for investigation work. The States, in their wisdom, have seen fit to supplement this expenditure by a considerable sum in various cases. In carrying on investigation and teaching with the same force, there is apparently a tendency to have agricultural employees act first as teachers and secondly as investigators. I think examination will show, however, that the expenditure of money for agricultural purposes is in favor of the investigation side rather than the teaching side. Now, an investigator must be protected in many ways if he is going to do good work. He can not afford to wear himself out in routine teaching. I believe that while our best investigators are or may become fine teachers if they turn their minds in that direction, men of smaller caliber can make fair teachers, especially of the elementary branches. The investigator must be a man of an inventive turn of mind; he must be patient and resourceful; he must be willing to go out into the dark and try to make the dark places light. The combination of qualifications necessary for an investigator is often not possessed by the good teacher. Many a good teacher is not an investigator at all. Many good teachers are men whose services can be purchased for a reasonable sum if the branches taught are put in good pedagogical form by some one who has preceded them. The experiment stations are bringing forth the data which make agricultural pedagogy possible.

The object of this resolution is to urge upon our colleges the importance of keeping the investigators purely upon investigation, or if that be not practicable, then to let them direct the teaching rather than to have the teachers primarily direct the investigation. While this resolution is not obligatory or compulsory, it will, I believe, if placed upon record as the sentiment of this Association, have a healthful effect upon our college presidents and others in authority, in directing the scholastic and investigation work of our institutions.

J. H. Worst, of North Dakota. Mr. President, the institutions in some of the States—such, for instance, as ours and our little sisters farther west—are hardly able to divide this work perhaps as it should be divided. In North Dakota, for instance, the head of the department of agriculture will perhaps use three months of the year in giving instructions in agriculture or animal husbandry. Now, I would like to ask whether it is the intention of the mover of this resolution to eliminate all teaching from the work of the investigator; or will he still be allowed during the winter months to devote a part of his time to teaching in the line of the specific work in which he is engaged in investigating during the summer?

W. A. Henry. I would desire that the men most highly qualified as investigators should have no teaching work or but a very small amount, and that limited to the higher branches of their respective subjects. I would desire that the investigator should have charge of the teacher rather than the teacher should have charge of the investigator.

In many of our institutions I think you will find there are young men—recent graduates—employed to investigate. It would be better, in my judgment, to employ such persons as teachers. Young men may be able to teach elementary agricultural chemistry, etc., but the recent graduate can not investigate questions of agricultural chemistry. He has not yet got beyond the books which are right in front of him. It requires years of study and investigation to enable him to penetrate profitably the problems of agricultural chemistry.

For instance, a young man just graduated can analyze foods according to the present methods of chemical analysis, to determine their nutritive value; but how many recent graduates can take up the work of advanced investigation involved in the food problem? The man engaged in such work has to go to the confines of agricultural chemistry. A much less mature man, a man who has not gone nearly so far in the study of the subject in hand, can do elementary teaching in agricultural chemistry, although almost worthless as an investigator. For investigation work which is to discover anything of value, you must have men on broad training and years of experience. Men of ordinary ability may be employed to teach; with youthful ambition and zeal they may make good teachers.

J. L. Snyder, of Michigan. Mr. President, I believe that this resolution, if it means anything, means harm. It brings up the same old question—which shall be subordinate, teaching or experimentation? Now, I do not believe we are able to say that the work of the teacher should be subordinate to that of the investigator. On the other hand, I do not believe we are able to say that the work of the investigator should be subordinate to that of the teacher. The determination of such a question depends altogether on circumstances—upon the personal qualities of the investigator and upon the particular demands of the work he is doing.

Of course in the earlier stages of agricultural study it has been necessary, as it is often necessary now, to impose to some extent upon a single person the work of both teacher and investigator. But we are gradually growing out of that condition. Let us not now put on record a resolution which shall discriminate in favor of either the one or the other. I believe the resolution should not be adopted.

E. B. Andrews, of Nebraska. Mr. President, I do not altogether agree with the gentleman who has last spoken, though I do so in part. I wish to submit a motion to amend the resolution so that it will read as follows:

> *Resolved*, That it is the judgment of this Association that the directors and the heads of divisions of station work should spend their best efforts in the station work and act secondarily as teachers in a limited way, etc.

If this amendment be adopted, I shall be in favor of the resolution. I agree with the gentleman who last spoke that it is not desirable that a man whose main function is investigation should be entirely cut off from teaching work. It seems to me that the great generality of first-class investigators in this world have been teachers—

teaching, to be sure, in a great many instances in a somewhat limited way. It has been often observed that the professors of German universities, where a great deal of teaching is going on in which they participate, have produced more in the way of investigation than the professors of English universities, who, as a rule, have taught very little, who are supposed to devote their entire time to investigation. I appeal to well-informed gentlemen here to sustain me in the assertion that every man who has sought to investigate at all has found that ideas obtained in the laboratory have been reduced to practical and profitable form by teaching; has been able to make them the basis of new ideas by teaching them to the classes. But I do believe that those who are pursuing their investigations upon the basis of the fund known as the Hatch fund ought to adopt as their principal business the work of investigation and make their teaching business subordinate to that. These, briefly stated, are my reasons for moving the amendment.

C. F. Curtiss, of Iowa. Mr. President, I believe that this resolution in its spirit is correct. I think it is well recognized by members of this Association that the educational work in a great many of our land-grant colleges has grown rapidly of late and that the tendency in a majority of cases has been to encroach upon the work of investigation. I do not think it practicable or desirable for this convention to discriminate in favor of the work of investigation as against the work of instruction. I do not believe that any such thing is contemplated by this resolution. But I think it should be kept clearly in mind that the work of investigation ought not to suffer by the increased demands made upon the college in the way of instruction, although these are demands which all of us are very glad to see increasing. I believe that the work of investigation ought to be kept prominently in mind. I am not particular as to the exact form in which this resolution may be passed.

J. K. Patterson, of Kentucky. Mr. President, I have the impression that when the Hatch Act was passed it was intended mainly to facilitate investigation and to provide funds for that purpose. If that be true, it follows as a matter of course that at least $15,000 a year ought to be devoted in these experiment stations mainly to the purposes of investigation. But when substantial results have been reached by investigations who is better fitted to impart the facts to the pupils than the investigator himself? If these results are worth anything, and are to be given to the world, why ought they not be given primarily to the matriculates of the institution under which these investigations are made? I know it very often happens that a man who is a first-class investigator is a poor teacher, and, vice versa, a man who is a good teacher is often not a very good investigator. But it does often happen that the two qualifications go hand in hand. As has been very aptly said by President Andrews, of Nebraska, many of the best investigators in the world excel also in imparting the results of their investigation to their fellow-men. This is notably true of the men who have been shaping the destinies of modern civilization in conjunction with modern science, both at home and abroad. I know of no more notable example in this respect than the famous Lord Kelvin, a man who stands in the front rank as an investigator and yet is one of the best of teachers. This eminent man, when he makes any discovery calculated to benefit mankind does not hand the results over to an intermediary to be communicated to his pupils, but is proud to go himself before his classes and communicate those results; and he does this with greater effect than any intermediary could.

Now, this is a matter which will very largely adjust itself. If a university or a college connected with which there is an experiment station has a great abundance of money, it will make the necessary differentiation. Some men will be relegated almost exclusively to the domain of investigation while others will be relegated almost exclusively to the domain of teaching. But it very often happens that some of these colleges are not so wealthy as others. I know of some within my own State that have only thousands with which to operate, while others have tens of thousands.

Now, if you introduce any arbitrary differentiation of this sort, it seems to me that the purpose of the establishment of these agricultural colleges and experiment stations will be very largely frustrated. Let the colleges adjust the matter themselves. Do not apply any hard and fast rule which will be construed by the boards of regents and by the managers of these institutions as obligatory upon all. I take it that each of these institutions, if properly officered and properly governed, will be able to adjust these matters to suit its own peculiar circumstances, and to choose its own peculiar lines of investigation. Each institution knows the means wherewith it has to operate; it knows exactly what it can accomplish, and what it can not accomplish. As soon as the men in charge of these matters get more money they will be able to differentiate and to open up lines of investigation that have little to do with instruction as well as lines of instruction perhaps that will have little to do with investigation.

But I come back to the original point of my contention, that the best investigators, generally speaking, are among the best instructors; and a line of arbitrary differentiation ought not to be introduced which will in any degree tend to handicap or hamper these institutions in the administration of the funds which they get primarily from the General Government and secondarily from the States in which they are established.

W. A. HENRY. I agree with the gentleman who has just taken his seat in many of his expressions; but I contend that when the United States Government gave $15,000 to each of these institutions it was with a definite purpose, viz, to promote investigation. I believe that the original object of this benefaction has often been lost sight of. I hold that some men who are nominally experiment-station men are so hard worked as teachers that they take up their lines of investigation wearied and ill-fitted to perform their very arduous tasks. I believe that in many cases the president and trustees of the institutions are forcing these men to do a large amount of instruction, thus causing the work of investigation to suffer. There are many trustees and presidents who are born educators but not investigators—men who are thinking all the time how they can get their scholars through the classes and enable them to earn diplomas. Such men are apt to lose sight of the real object of this $15,000 appropriation—are apt to bend the time and energies of their institutions in the direction just stated. I want to see the legitimate expenditure of most of this $15,000 in direct investigation. I believe that when this is done the institutions will advance more rapidly, will have more patronage, and secure more funds. I do not believe in putting five-hundred-dollar men to carrying forward investigation work under the direction of two-thousand-dollar teachers.

H. J. WHEELER, of Rhode Island. Mr. President, I think we all agree with President Patterson that there should be no hard and fast lines of distinction drawn between the teacher and the investigator, and that opportunity must be given for each to develop his own capacity in his own field. But let me call attention to what the world would have lost if the distinguished man named by President Patterson as a magnificent illustration of his position had been tied rigidly down to teaching—had been driven into that field and given no opportunity to develop his wonderful talent for investigation.

I contend that the investigator is by long odds the best teacher; but my point is that no man is fitted for investigation if he is required to do a large amount of elementary instruction. What is the protection to which a man is entitled who has to endeavor to push the confines of agriculture farther and farther? This man must be courageous; he must be assertive, but at the same time conservative, and he must be possessed of the best faculties required for the work of investigation. Certainly he can not be in a proper frame of mind to do thorough investigation work if he comes to that work wearied by the duties of the class room where he has been obliged to teach 100 or 150 freshmen the elements of agriculture.

The real question is, Shall such a man wear out his faculties in teaching elementary agriculture? I am most heartily in favor of the resolution in one form or the other.

E. B. Andrews. Mr. President, I understand that Professor Henry's main idea is simply that as an association we shall take the ground that the money coming to the land-grant colleges under the Hatch Act ought to be honestly expended. On that point we all agree. I believe that all of us who have had charge of the administration of the fund are aware that there is a pressure—and we have sometimes been obliged to give way to it—to use some portion of that fund for teaching purposes. As I understand, we have no right to use any part of it for that purpose. It is a fund for experimental purposes—to get knowledge into existence and not to get it into the heads of particular pupils. The object is to cause the knowledge to come into existence, so that the world at large may know it.

Now, it seems to me highly desirable that in all these matters where we have to do with Government funds we should be absolutely honest. I know that we all desire to be so. I believe we are all working as hard as we can to accomplish that object. But I believe that this resolution in its modified form will be a helpful thing for all of us to have in mind in dealing with our governing boards, who may never have read the terms of the Hatch Act. They want to do the right thing; they are as anxious as we are not to cheat the Government in any particular; but they do not in all cases know the law as well as we do. I think this resolution would be very proper coming from this association as a sort of interpretation of the law under which we are trying to work. I think it would be helpful, and I hope that in a modified form it will pass.

J. L. Snyder, of Michigan. If any college is disposed to make a misappropriation of any of the funds contributed to it by the Government, I understand it is the duty of the Department of Agriculture to set that matter right. We are compelled to submit reports of our expenditures, and there is an officer of the Department who comes around to examine into our expenditures. It is his duty to see justice done.

The reason I object to this resolution in any form is this: There has never been any ruling of the Department, so far as I know, that would indicate a preference for one class of work over the other, but if we adopt this resolution we simply say to the colleges and the boards of regents, the boards of control, that as between experiment-station work and teaching work, the experiment-station work should have the preference. I do not believe that we should put ourselves in that position. In some cases the investigator should have the preference, in other cases he should not. I do not believe there is any work of a higher order than the work of giving instruction to young men and young women, and I shall not vote to say that the work of investigators is of more importance. I believe that this convention will make a great mistake if it puts itself on record in that way.

L. G. Carpenter, of Colorado. Mr. President, I do not understand that this resolution fixes any hard and fast rule which would bind any institution. But in many of our smaller institutions where there is a rapid development in the course of instruction and a great increase of students, there is an insidious encroachment upon the work of the investigator—not necessarily by those in authority, but from the fact that as classes increase, as students multiply in number, there is an increased demand, which can scarcely be resisted, upon the time of the professor. In this way I have known men to attempt to carry on continuous investigation who at the same time have been attending to class work five to eight hours a day. I do not say that this is in consequence of any influence exerted by the heads of the institutions, but I think that some general declaration of the principles which should govern this matter would conduce to a better conduct of the work of investigation in a great many institutions.

E. A. Bryan, of Washington. Mr. President, with the general intention of this resolution I am in hearty sympathy. It seems to me that as this resolution may be construed, the ultimate tendency would be toward an entire separation of experiment station work from instructional work. I am not willing to go so far as that. I believe that both these classes of work represent different sides of a great educational movement and that they should not be separated; that not only for the next year or the next decade, but perhaps for many years to come there should be a very intimate connection between the work of investigation and the work of instruction, and that the instructional work should not lose the advantage of having the help of those who are investigators. I think it an extremely important thing that the young student should come into close contact with the investigators, that problems involving investigation should be set for him, and that he should become part and parcel of the investigations taking place.

To this extent I am in favor of the resolution: I believe in protecting the investigator from being overburdened by instructional work. So far as the resolution may work in this direction and in the direction of securing a proper expenditure of the Hatch fund I am in favor of it. But if it looks toward an ultimate segregation of these two parts of a great educational system, I would be distinctly opposed to it. I believe that one of the most important things in the development of this movement thus far has been that the two sides of the system have been connected.

I know that sometimes men have gone to investigation work worn out with class work, and sometimes have gone to instruction work worn out with their work as investigators. The pressure has been very great from both sides. This is greatly to be deplored. I know, too, that to some extent instructional work has encroached upon the fund designed for investigational work. This also is greatly to be deplored. Anything of that kind should be avoided if possible. But if the resolution looks toward the segregation of these departments until finally we shall have institutions in which we shall have men on the one hand devoting their time and attention to investigations on the outskirts of science and not particularly in sympathy with those who are giving instructions to their classes, and on the other hand men who have little knowledge or little care as to what may be going on in any other than the teaching department—if that is the ultimate tendency of this resolution, I oppose such a movement. I do not think such a proposition would be wise. I believe that the resolution in that view would be at any rate entirely premature.

C. Northrop, of Minnesota. All the good that can be accomplished has been, I think, accomplished by the presentation of these various views in the discussion here. I believe we shall be just as well off if we do not adopt any resolution on this subject. I move, therefore, that the whole matter be laid on the table.

The motion was agreed to.

Evening Session, Tuesday, November 12, 1901.

The convention was called to order at 7.30 p. m., President Harris in the chair.

Report of Section on Mechanic Arts.

H. W. Tyler, of Massachusetts, submitted the following report for the section:

Mr. President and Gentlemen of the Association: The by-laws of the Association make it the duty of the chairman of the Section on Mechanic Arts to make at the annual convention a report of the progress during the preceding year on the subject or subjects appertaining to this section, or, as I understand it, on progress in engineering education. I take it that no one can expect this report to contain any complete statement of such progress, but that the limitations assigned are intended to be suggestive as to the general aim of the report. Nevertheless, I shall take the liberty to speak also somewhat more particularly of the scope and function of the mechanic arts section, believing that the Association has still to reach a better solution of this problem, and that the discussion of the problem, if not strictly within the limitations assigned for the chairman's report, is worthy of most careful consideration by the Association at large.

With a view to preparing at least a partial report on the lines indicated by the by-laws, certain information has been collected and studied.

It is fully realized that this portion of the report is not in any sense complete, and

I much regret that the limitations of time and opportunity have made a more satisfactory result unattainable. It may well be, however, that the solution of the problem is only relatively inadequate, since no one person can expect to report comprehensively on the progress of engineering education in the United States for a given year, unless he have time and other resources not likely to be contemplated for any officer of this association.

I may note first the meeting of the Society for the Promotion of Engineering Education held at Buffalo in June and July, 1901.

In answer to an inquiry as to papers specially notable for my present purpose, the secretary of the society has favored me with advance proof sheets of two papers. The first is by Prof. J. B. Johnson, dean of the College of Mechanics and Engineering of the University of Wisconsin, and deals with "Some present tendencies in higher education." Professor Johnson opens his paper with a reference to the fundamental position in engineering education of mathematics, mechanics, physics, and chemistry, and emphasizes particularly the importance of presenting them to students with direct reference to their efficient use in the solution of problems in engineering. He proceeds then to dwell on the importance of having education in these general subjects given by men who have had experience in making such application, or, as he says, "the instructor must know something of the application to be made in engineering practice of the facts and principles which he sets himself to expound." Further on in his paper he speaks of "the importance of a separate and independent faculty of those who give instruction in engineering studies, even though members of that faculty may also be connected with the literary or some other faculty of the university." He disclaims any subordination of scientific methods in experimentation to mere utilitarianism and deprecates too close attention to details of cost which may depend upon purely temporary conditions. Near the close of his paper he discusses relief for the college curriculum by increase of entrance requirements and by the differentiation of collegiate work into special courses. He expresses the view that the present exceptional position of the colleges for engineering as at once professional, and undergraduate schools as not likely to be changed in the near future, and draws the inference that "the intimate cooperation of undergraduate schools of engineering with schools of letters and science now found in the American universities is a normal, a wholesome, and an economical one, and not a subject of legitimate criticism."

Prof. W. G. Raymond of the Rensselaer Polytechnic Institute, presented a paper entitled "The promotion of engineering education and graduation requirements," although I think Professor Raymond would agree with me that neither this title nor any other brief one would fully characterize the scope and aim of his paper, which deals in a searching way with some of the fundamental principles of engineering education. Some of Professor Raymond's critical points of view may be indicated without attempting to present an abstract of his paper. He suggests as fundamental mistakes in our present work, first, "too much vacation; the school year should be lengthened and the number of years lessened; second, class work instead of work with the individual; third, the mixing of engineering subjects with preparatory and general culture subjects, and what seems to him another fault is specialization in what is usually an undergraduate course." He says that "the course for the baccalaureate degree should be general, involving the fundamental of all branches of engineering; the professional or master's degree should follow advanced work in a particular department, either in school or practice, as may seem advisable." With a view to substituting work with the individual for class work, he proposes that "there be provided one or two or more general lecture rooms, to be used by all instructors for class work, and for each teacher a large workroom with a comfortable office adjoining; also that each student shall pursue a single subject, or, at the most, two subjects, at one time and until completed. During this period of work in one subject he will occupy a desk, with book rack and drawing table (when necessary) attached, in the work room assigned the teacher under whom he works. Here the student will study, conferring with his teacher when necessary, for, say, eight hours daily, until the subject in hand is mastered. He then goes to another teacher in another room. When the attendance is small and one teacher handles several subjects, the scheme is not essentially different; the student simply remains in one room longer, and the equipment of the room will vary. To secure the greatest economy of time, he suggests that the engineering course should be separated from the other subjects in the school. As it is now, some engineering subjects, as surveying, technical drawing, etc., begin in the so-called freshman year, while descriptive astronomy, political economy, etc., are frequently left to the junior or senior year. In order to accommodate students coming from various schools, and the student of advanced age and limited means, but with a good head, who must prepare himself; in order to make the course attractive and economical as to time to college graduates, a class of students we should all like to see increase; and in order to carry out the plan already mentioned, it is desirable to separate the engineering studies from the other undergraduate courses and to make the engineering course complete in itself. Although it is not done now, we hope the time may come when we can require a baccalaureate degree for entrance to an engineering school." He says, further, that the stock of engineering knowledge has become so great that few men master it all, and it is more than can be expected that a student will master the details of all branches of the profession while in school. At the same time, the various branches are so interrelated in all great engineering operations that every civil engineer should know something of the principles of mechanical engineering, electrical engineering, mining engineering, etc., and vice versa. Therefore it would seem to be wise to teach in the school the fundamental principles and general practice of all branches, making the accomplishment of a complete course of this character the requisite for a baccalaureate degree in engineering. Subsequent work of note in one or more branches either in practice or school may be rewarded with a professional or master's degree. He proposes the following outline for a general undergraduate course in engineering for discussion:

"Physics, 150 hours; chemistry, 50 hours; engineering materials, geology, mineralogy, metallurgy of iron and steel, 50 hours; mechanics, 150 hours or less; theory and general design of prime movers and transmitting engines, 150 hours; theory and general design of static structures, 100 hours; theory and general practice of road and railroad location and construction, 50 hours; theory and general practice of sanitary engineering, 50 hours; theory of surveying, 50 hours; drawing, 300 hours; surveying field work, 300 hours; and physical and mechanical laboratory, 300 hours."

He says that "stating the hours spent in a subject is a somewhat unsatisfactory way of defining the extent of the course to be given, but it may be said that it is intended to include so much of mechanics as is now given in any undergraduate course, and that the hours allotted to this and the other subjects will indicate the writer's first thought as to their relative importance." In conclusion he makes a suggestive comparison of some parts of his plan with the methods of the business colleges and correspondence schools.

While I can not assume that this brief outline of two papers can have much intrinsic value, I trust it may not be out of place to remind the members of this Association of the existence and importance of the society.

Inquiries have been sent, although not so seasonably as was to be desired, to representatives of each of the colleges included in this Association asking information as to progress during the year. I am indebted to the courtesy of the college officers for the following notes, which it need hardly be said make no claim to completeness:

The Alabama Polytechnic Institute reports its engineering departments crowded and the work progressing satisfactorily.

The University of Arizona reports the completion of a manual-training building with a total floor area of 7,900 square feet. The power room contains two engines, a dynamo, a blower, and an exhauster. The wood-working shop is equipped with a full assortment of hand tools, 4 wood-turning lathes, a universal wood worker, a dimension sawing machine, and other modern wood-working appliances. The forge shop contains 24 down-draft forges, 24 anvils, a blacksmith drill press, and all necessary small tools. The machine shop contains 2 engine lathes, a shaper, planer, universal milling machine, 24-inch drill, grindstone, vises, and small tools. Other machinery is being constantly added. New engineering courses are described as follows: Engineering work underground: Methods of mining, ventilation, explosives, analytical design of a steel hoisting frame. Metallurgy: I. Iron and steel, copper, lead; special reference to the mechanical operations of ore reduction; complete analytical design of a roaster, smelter, or some equally important structure will be given each year. Engineering construction and hydraulics: 1, 2. (a) Engineering construction first semester; materials of construction and their properties; masonry construction—culverts, bridge piers, dams, retaining walls, arches; graphical investigation of stability; use of concrete; foundations, pile, and masonry on land and water; cofferdams, cribs, and caissons. (b) Hydraulics second semester; velocity and discharge from orifices, weirs, tubes, and pipes; flow in sewers, ditches, canals, and rivers; energy of a jet; measurement of a water power, water wheels of various types; pumping machinery. Steam engineering and prime movers: 1, 2. Elementary thermo-dynamics; theory of steam engine; types of engines; steam valves and valve diagrams; theory and use of the indicator; compound engines; heat and combustion of fuel; types of boilers; design of chimneys; gas, oil, and hot-air engines; solar engines; wind and water as natural sources of power.

The University of California reports that the courses in electrical engineering, particularly in laboratory work, have been strengthened by the addition to the laboratory of a large amount of alternating-current apparatus. The laboratories have been thoroughly equipped for experimentation in hydraulic and in steam engineering.

The Colorado State Agricultural College reports the introduction this year of the chair of architecture as a part of the mechanical department, and of a four-year course in architecture leading to the degree of B. S. The course has the indorsement of the Colorado Association of Architects. The outlook for the success of the course is unusually flattering.

The University of Georgia reports progress in the building up of the school of civil and electrical engineering and putting it on a firm basis as among the most valuable of its departments; the relative increase in attendance of students being, moreover, most gratifying, including, for example, graduate students in electrical engineering for the first time in the history of the university.

The University of Illinois makes an extended statement, mentioning the erection and equipment of three new buildings, greatly increasing the opportunities offered. In architecture increased attendance and enlarged equipment are reported, and a tendency toward architectural engineering, on account of the numerous opportunities for employment in the design and erection of steel construction. In electrical engineering continued work is reported on an artificial transmission line. In shop practice 279 students are reported, an increase of 30 per cent over the previous year. Provision was made by the last legislature for the construction of new wood shops in a separate building, and these shops will probably be completed about January, 1902. The equipment of the building will cost $6,000, the building itself about $18,000. A new building for the laboratory of applied mechanics is expected to be ready for occupancy about January 1, 1902. The front portion of this building will be used for the material-testing laboratory and the rear portion of the wing for the hydraulic laboratory. The material-testing laboratory will be equipped with a 200,000-pound testing machine, a 100,000-pound testing machine, a 230,000-inch-pound torsion machine, a beam-testing machine, and various other machines and appliances. The hydraulic laboratory will have a 4 by 60 foot steel standpipe, permanent piping around the building, masonry weir tanks with two 3-foot weirs, masonry tanks for measuring water, current meter rating conduit, weir tanks, orifice tanks, motors, turbines, an 8-inch Venturi meter, pump, etc. The university waterworks, now nearly completed, have been designed to be used for laboratory purposes. The tanks, pumps, and reservoir will permit experimental work, both on the waterworks system and also in furnishing water supply to the hydraulic laboratory, and will be a valuable auxiliary.

Purdue University reports the resources of the department of mechanic arts to have been largely directed toward increasing the equipment in practical mechanics and laboratory facilities, in which direction several thousand dollars have been expended. While little apparatus of absolutely new character has been added during the past year, considerable progress has been made in other directions. A professorship in car and locomotive design has been established, and work is being pushed in that direction. Steps are being taken to provide instruction in telephonic engineering. An important beginning has been made in the way of a railway museum by securing three types of American locomotives, which have been permanently deposited with the university, and sections of antiquated and obsolete track, showing early forms of construction, have been collected. In the way of research a large amount of work has been done upon the photometric value of arc lamps in connection with the National Electric Light Association, and important tests of triple valves and brake shoes have been made in connection with the Master Car Builders' Association.

The Iowa State College reports an unprecedented attendance of students, the strengthening of the engineering courses, especially that in mining, and the erection of a new fireproof building at a cost of about $200,000.

The Massachusetts Agricultural College reports an advance in entrance requirements in mathematics and a change of calendar to the two-term basis.

At the Massachusetts Institute of Technology three graduates of the United States Naval Academy are taking a specially arranged course in naval architecture leading to the degree of master of science.

Entrance examinations have been held for the first time in England with some effort to enlist the interest of English teachers and parents. The results of the experiment, while not important numerically, appear to warrant its continuance, as England is notably deficient in opportunity for engineering education of an advanced character.

The University of Minnesota reports the number of students at the college of engineering much greater than formerly. The buildings have been increased by the erection of a laboratory, a lighting and power plant, and a large addition to the mechanical engineering workshop. It is stated that there is such a demand for engineers that the college has a very important mission to fulfill.

The University of the State of Missouri reports, among other interesting details, that the last legislature gave for civil, electrical, and mechanical engineering at Columbia $40,000, of which about $13,000 will be expended in extending the laboratory and $27,000 for increase of equipment. This, in addition to what they already have, will give them a very handsome lift upward in engineering. The legislature gave $25,000 for equipment of laboratories, out of which will be expended not less than $1,500 for the better equipment of the machine shop in the mechanic arts building. The same legislature gave $25,000 for libraries, of which engineering will get its part. For the school of mines and metallurgy the last legislature appropriated about $90,000 for buildings and equipment. Adding all together, in buildings, books, and equipment, civil, electrical, mechanical, and mining engineering and mechanic arts, the University of Missouri has received in the last twelve months not less than $133,000.

The professor of mechanical engineering of the university has made an exhaustive study of all the coals of Missouri, testing (with the cooperation of their station chemist, Dr. Schweitzer) their thermodynamic values. The bulletin has been widely called for. The professor of electrical engineering during the last twelve months has made an exhaustive study of the water power of Missouri, publishing the result in an edition of 3,000 copies. The aim was to show how the power might be transmitted by wire to the nearest railway station. The department of civil engineering, geology, and chemistry are combined in an exhaustive study of the cement deposits of the State, or of what seem to be beds of cement.

The Nevada State University reports that it is making preparation to add very largely to the equipment of the mechanical engineering school next year.

The North Carolina College of Agriculture and Mechanic Arts reports as in process of erection a new two-story brick building with basement for textile instruction and an equipment of textile machinery valued at about $12,000, all secured since the last meeting of the Association.

The North Dakota Agricultural College reports that during the past year the building occupied by the department of mechanic arts has been increased to almost double the original floor space. The present forge shop, 48 by 54, contains forty Buffalo down-draft forges. The new laboratory of steam engineering contains three steam engines and two gasoline engines of various makes. In addition to the regular four-year course in mechanical engineering there has been established a two-year course in steam engineering, to meet the demand for training in that line in the State. The attendance had last spring increased to the limit of the accommodations.

The Oklahoma Agricultural and Mechanical College reports that through an appropriation of the Territorial legislature last winter the college has been enabled to construct a new and commodious building for the housing of the department of mechanical engineering, the older building to be used for shop purposes only. The new building is in process of construction and will be ready for occupancy next year. Entrance requirements in this course are the same as for the other courses, but the lack of a sufficient grounding in mathematics is felt, and the establishment of more extensive and rigid requirements in this line is looked forward to.

The South Dakota Agricultural College reports a new building for engineering and physics.

The University of Tennessee reports that in all the engineering lines there has been a decided expansion in the number of students in these studies and a somewhat corresponding enlargement in the equipment. The same thing will be felt in the more advanced work next year and the year following.

The report from the Washington Agricultural College is that the particular change in curriculum has been the introduction of a so-called school for artisans—a one-year course in purely mechanical work offered to persons over 21 years of age who may be recommended by the department for such a course. It includes, among other things, work with the traction engine, a matter of considerable importance in that region.

The West Virginia University reports the present outlook for the department of mechanic arts to be bright. A new building is under roof and will be ready for occupancy by the 1st of January, 1902. The legislature at its last session provided funds for the immediate equipment of the building, and the work of installation has already begun. By the end of the present college year it is expected to be running under normal conditions and to have an equipment that will compare favorably with those of other institutions of the same grade. The new building is very well suited for the purposes for which it is intended and has ample floor space for future extension.

The University of Wisconsin has conducted for the first time a summer school for apprentices and artisans, in regard to which Professor Johnson writes me:

"Please note that the moderate success we had away off here in Wisconsin and in the country should not be accepted as a measure of the success that would follow such an effort on the part of a school in a large manufacturing city. The fact, however, that we are a State institution, and the complaint that has sometimes come to us from legislators, newspaper editors, and others that we help only those who can afford to take first a high-school course and then four years in college, has caused us to feel that we ought to try to do something for the industrial classes who can not afford to spend so much time in school. Our offering to do this, even though the number of students taking the course is small, brings us, I am sure, the friendship of a larger constituency which otherwise would be more or less indifferent."

The reports he transmits indicate a corps of instruction including 10 members, the work offered being steam engineering and applied electricity. Forty-five students were registered, of whom 17 were students of the college of engineering who took advantage of the facilities of the summer school in order to make up shopwork. The other 28 included draftsmen, inspector of railway motive power, professor of mechanics in engineering school, professor of mathematics in engineering school, teacher of manual training, machinist, central electric station employee, gas-works employee, engine-shop foreman, lineman, stationary engineer, machine-shop apprentice. The object of the instructor in each study was to select the portions of his subject having the greatest bearing on the conditions met with in practice, and then to present these portions in as clear a manner as possible, making use of the minimum of mathematical formulas on account of the wide variation in the preparation of the students. In the laboratory work divisions of small number must be arranged, as no time can be used for preliminary practice with the instruments, which must be constantly under the eye of the instructor. It was found by the faculty, working as they did under the above conditions regarding class room and laboratory work, that a large and satisfactory amount of ground could be covered in the six weeks' period. Many of the students had had correspondence-school instruction, which was well supplemented by the summer-school work.

This experiment, if it may be so termed, is one of no little interest, especially in view of the extraordinary development of the work of the correspondence schools. I assume that an account of the work already done may be obtained in print from the officers of the University.

The University of Wyoming reports additions to shop equipment, and that its mechanical department is in far better shape than ever before.

Referring now to the general policy of this section, I may express my point of view by quoting the following letter sent early in the year to the officers and members of the executive committee of the Association:

"Having accepted the chairmanship of the Section of Mechanic Arts (of the Association of American Agricultural Colleges and Experiment Stations), and believing that so long as such a section is maintained its efficiency should correspond, so far as practicable, with the standing and importance of mechanic arts in the broadest sense, not only in the act of 1862, but in the actual work of our land-grant colleges, I respectfully invite your attention to the following considerations:

"In view of the well-recognized standing and value of the Society for the Promotion of Engineering Education, and the great engineering societies, it seems to me not to be expected that professors of engineering will or should be attracted to our annual meetings by any attempt to secure addresses or discussion on special technical engineering topics.

"So far as I am aware, the agricultural side of our work is not similarly situated in this respect, and our Association—or rather its sections on agriculture, etc.—may well afford the best opportunity for the presentation of technical papers. I note the contrast only to indicate why I prefer a different policy for the mechanic arts section.

"Ruling out special technical subjects, there still remain what may be indicated, without exact definition, by the following heads:

"I. Engineering subjects of a general character.

"II. Engineering education from the general or administrative standpoint.

"To be more specific, I should include under I such definite titles as the following: Irrigation, water supply and sewerage of cities, methods of transmission of power, American architecture; and under II, effect of engineering education on industrial progress (to be treated not in a merely speculative way, but by a specialist with reference to concrete instances), relations between higher and secondary education in the mechanic arts, variety in engineering education (considerations affecting the number of professional courses to be offered), status of literary studies in engineering courses, and standards for engineering degrees.

"One or two of these large subjects should be sufficient for a particular convention.

At the Washington meetings efforts should be made to secure the participation of men holding important posts in the engineering work of the Government.

"It is evident that no steps should be taken in the directions indicated unless the Association is sufficiently interested in the result to make the sessions at which such papers could be presented an entire success in attendance and otherwise. Before making any effort to secure papers, I desire therefore to secure as full an expression of opinion as possible of the attitude of the Association. May I therefore trouble you to advise me at your early convenience as to (1) your personal opinion of the plan outlined, (2) your judgment as to its practicability, (3) your choice among the subjects named or others of like scope? Incidental criticisms and suggestions will be appreciated."

I am indebted to the persons receiving copies of this letter for prompt and courteous responses, and have many interesting and valuable expressions of opinion. While it may be out of place to quote these with the writers' names (as they were not, of course, prepared for publication), it is not, I think, superfluous to indicate in this report the general character of the views expressed.

In the main the criticism of correspondents was gratifyingly favorable.

The first is of opinion that there are questions in engineering in connection with the interests of agriculture which could be taken up successfully and would be of great interest and value. The teaching side of the question is a valuable one and it would be a good idea to secure such men among the presidents as are particularly interested in the promotion of engineering education. This writer is of opinion that there should be no distinct section on mechanic arts, and that such papers as are suggested in the circular letter should be presented either to the general association or to the section on college work.

Another, writing from the experiment station standpoint, expresses the view that strictly technical papers on whatever subject should be avoided, and that the time of the Association should be mainly confined to the work of administration, and to the general considerations pertaining to courses of study and methods of instruction and investigation, and to the relation of technical education to industrial conditions and progress, both broadly and as related to special lines of practice. The various scientific and professional societies in the country offer the most desirable and attractive opportunities for the discussion of purely technical science. This general policy of managing the Association is equally applicable to all of its departments.

A third is of opinion that the college and station association is not a society for the discussion of technical matters, its special province being the consideration of administrative problems and technical matters relating to the organization of new lines of work.

A fourth believes that the work of the Association and its several sections should be confined to subjects of a general character and questions relating to the policy and administration of the institutions and departments represented in the Association; that we should have a carefully prepared programme, including only a very few topics each year, and that arrangements should be made in advance to have these topics thoroughly presented and discussed, as there are other associations which are much better adapted for the presentation and discussion of technical and scientific papers. Also, as regards subjects for the section of mechanic acts, that those who are especially interested in agricultural education and research should be glad to have matters discussed relating to rural engineering, including irrigation, drainage, water supply for farms, road-making, and farm machinery.

A fifth expresses his firm belief that this division of the Association could be made of great value in developing and systematizing courses in engineering presented by our land-grant colleges; that he believes the Association might be interested to such an extent that the next convention would be marked by a much greater sympathy for engineering science. He suggests that the chairman bring before the Association at the next meeting the subject of the effect of engineering education on industrial progress—a subject so comprehensive that civil, mechanical, electrical, mining, and sanitary engineers might participate in the discussions.

A sixth correspondent is impressed with the plan outlined as being entirely practicable and one which if followed would result in improving the work of this particular section of the Association.

Still another writer says that the object of the formation of the Association was not so much the discussion of special branches of work coming within the purview of the acts of Congress, as the creation of any agency which should help to stimulate the growth of sound opinion and practice among these institutions, which are necessarily subjected to such a great variety of external and internal influences, and, at the same time, a means of expressing to Congress and to the public an authoritative judgment as to the field that the land-grant institutions should occupy.

An eighth writer regards the proposed change of policy as not only practical, but wise and desirable. He considers what is said regarding the engineering societies as quite true. Even though those who are isolated and deprived of such advantages might prefer some special technical subjects, it is quite probable that the subject presented might not be of their own choice, and as a consequence not of the greatest interest, while some general subject should be of interest to all, and for this reason preferable.

Another gives his unqualified approval to the plan outlined in the circular letter and believes that two of these large subjects would be sufficient for any one convention.

I trust the citation of so many witnesses of such unquestionable competency may be accepted as sufficiently fortifying the position assumed by the chairman of the section as to the proper direction of its future work.

As to the execution of the plan proposed in the circular letter for the present convention, the chairman was unfortunately out of the country during the summer months, and on his return found that such other programme arrangements had been made by your executive committee as appeared to preclude adequate presentation of any of the main subjects proposed before the general association. Apart from this situation it was doubtless wiser, as it was certainly simpler, to present the general plan to the Association for criticism or sanction before undertaking to put it in operation, and such a presentation of the general plan is therefore included in the present report.

H. W. TYLER, *Chairman.*

The report was accepted.

COOPERATION WITH STATE UNIVERSITIES.

H. H. GOODELL. Mr. President, and gentlemen of the Association, a committee of five members of the Association of State Universities, now in convention in this city, has been appointed with the object of forming some plan of cooperation between the Association of American Agricultural Colleges and Experiment Stations and the Association of State Universities. A member of that committee came before the executive committee to-day inquiring in what way this subject could be brought before the convention. Your committee recommends that a special committee of five be appointed to meet the committee of five on the part of the State Universities and confer with them on the plan proposed.

The motion was agreed to.

The President announced the appointment of C. S. Murkland, of New Hampshire; G. W. Atherton, of Pennsylvania; W. M. Beardshear, of Iowa; W. O. Thompson, of Ohio; and W. E. Stone, of Indiana, as the committee on the part of the convention.

At a later meeting C. S. Murkland, of New Hampshire, submitted for this committee the following report, which, on motion, was received:

After reviewing the proposed plan of cooperation, as outlined in the communication from the Association of State Universities, your committee met in joint session with a committee from that body. As a result of that conference it was decided by the committee from the Association of State Universities that it was expedient to withdraw the proposition embraced in its communication to this Association. Your committee therefore unanimously recommends that the proposal for formal cooperation between the two associations be deemed withdrawn, at the request of the Association of State Universities.

In presenting this recommendation your committee wishes to record the expression of its own feeling and the feeling of this body that the two associations, having many common interests and constituencies largely identical, must in the nature of the case cooperate in maintaining educational principles, fostering educational ideals, and developing the educational resources of the several States. The peculiar relation between the National Government and this Association and its constituent members should in no way hinder the freest intercourse or the most mutual fellowship; such fellowship and intercourse being the natural outcome from the like comity between individual colleges and universities. And your committee particularly desires to record its hearty appeciation of the courtesy and good will embodied in the original proposition and constantly manifested throughout the conferences upon the said proposal.

Arbitration Congress at Charleston, S. C.

C. S. Murkland brought to the attention of the convention a proposition from Alexander D. Anderson, suggesting that the Association take some action with reference to a proposed arbitration congress, to be held in Charleston during the spring of 1902. The matter was referred to the executive committee, which reported that it was considered to be entirely outside of the province of the Association, and that it was inexpedient for the convention to take any action on the subject.

The recommendation of the committee was agreed to.

Address by the President of the Association.

J. K. Patterson, of Kentucky (acting as presiding officer pro tempore). Gentlemen of the Association of American Agricultural Colleges and Experiment Stations: I have the honor to introduce to you this evening President A. W. Harris, of the University of Maine, a gentleman long connected with this body, and whose active and efficient service was properly and commendably rewarded last year by his election as president of this body—the highest honor which a member of this Association can attain. He will now deliver the annual presidential address.

President Harris then spoke as follows:

Thirteen years ago I came into this Association. When I came I had slight appreciation of the meaning or importance of the cause in which I had volunteered; I fear I held for technical training something of that foolish feeling of superiority which the man of classical training often expresses in the word "utilitarian." I was of the straitest sect of those who only tolerated the new lines of higher education and believed that the higher education was properly outside the province of the State, which would best leave such work to private enterprise, thus avoiding the embarrassment of conflicting class interests and allowing the addition of a religious element, forbidden to the State but necessary to make what was called "Christian education." I have lost none of my admiration for my alma mater or the other institutions of her class; I can not walk through the pictured galleries of the great men and good who were the founders and benefactors of our colleges and universities without a deep stirring of the emotions. All honor to their noble company! They have rendered a great service, and they need no apologists.

Nevertheless, I am a complete convert to the system represented here. Had I spent my undergraduate days in a land-grant college or a State university I could not believe more deeply in the oneness of truth, in the essential equality of its forms, whether literature, or philosophy, or science, or the arts of commerce, manufacture, agriculture, and in the efficiency of the State education.

I have chosen as my purpose this evening to set forth briefly a few of the most important things for which the land-grant college stands, with a brief statement of results accomplished. I can not present much that is new, but hope to serve a useful purpose in formulating a few inspiring ideals which I have come to find in our system of colleges. By system I mean to include not only the institutions formally represented in this Association, but such others also as embody the same ideals, or some of the most important of them.

The land-grant and other State institutions having a common purpose and similar methods make a rare system, combining national aid and requirements with local control and administration in a manner fitted to produce the greatest efficiency, and closely in keeping with our governmental methods. The student of the land-grant act must admire its marvelous flexibility, which, while guarding its special purposes, has allowed the free development of the colleges, each in accord with its local conditions.

The first thing to be said of the land-grant colleges is this: They provided for agricultural education. Agricultural education has been viewed by this Association from so many standpoints and so often that I shall attempt no discussion of what it is or ought to be, but venture only to point out how important was the step taken when the Government provided college teaching and investigation in agriculture. This step was important to agriculture, but it was yet more important as the first sufficient recognition of study and investigation as the basis of the best success in great business and commercial fields, and it is equally important as a precedent-making recognition of Government action as the greatest and most effective form of cooperation for the gathering and dissemination of knowledge in regard to the pursuits in which the people are engaged. If the land-grant act had proved of trifling value to agriculture and the mechanic arts, it still would have been of enormous value because it laid down the principle that the Government, not that of the States only, but the National Government as well, had a duty in investigation and teaching for the benefit of industry.

This act is not, however, barren of the most important results to agriculture, and I might use my whole time in enumerating them. I take only time enough to refer to the greatest of these results—the experiment station. If the agricultural college did nothing more than to establish, maintain, and officer the experiment station it would be justified many times over. The experiment station is the child of the college. The idea, the soul, of the experiment station was in the college at the beginning; the creation and endowment of the station are due to the persistent and intelligent effort of the college, and the station must always be manned, as now, almost entirely by men prepared in the lecture rooms and laboratories of the agricultural college. I say these things thus pointedly because there seems to be in the thought of some a suggestion of an antagonism between the college and the station.

There have been criticisms upon the administration of the experiment station as conducted by the college, and some of these criticisms are just, but they apply to very few of the half hundred colleges in the country. Let us remember that these criticisms, even when justified, are not to be regarded as differences between the college and the station, but as errors, or, perhaps, faults, in the administration of officers of one combined institution who have the same responsibility for both instruction and investigation. Examination of station administration would show errors, but I am persuaded that it would show them to constitute a surprisingly small part of the whole. In weighing criticisms let it be remembered that they are offered for the most part against officers with a double responsibility by officers who, as a rule, consider themselves the special advocates of the station and enjoy a delightful freedom from the obligations of impartiality. We admire zeal in station officers, but we must not regard it as a sufficient or impartial basis for the arraignment of trustees and other officers whose enthusiasm for the station is properly tempered by the desire to give equal justice to each of two great trusts. Criticisms have given rise to the suggestion that the Department of Agriculture be given larger control of the experiment station. I believe in an efficient central office, but I fear any material increase in the authority of a central agency, lest it end in making the governing board of the experiment station—the mere executive agent of the central governing power—a worse evil than no central government at all. Even a Washington control would involve mistakes, and a strong centralization of authority would multiply every error by an alarming factor. Moreover, it is a great advantage of our present system that each experiment station has the opportunity to work out its own individuality. I believe it an advantage, too, that each board is charged with the administration of departments of instruction also, and is so subject to a continual broadening influence. To retain these advantages we may suffer some ills with patience.

The legal recognition of agricultural education was important for itself, but more so because it opened the way for the establishment of education in the interest of all industries and pursuits. The ten years preceding 1862 show a growing appreciation of science and its applications, strongest in agriculture, but including all interests. When scientific and technical education asked admission to our schools, they met such strong opposition from intrenched educational custom that any recognition must have been long delayed but for the tremendous power possessed by agriculture in virtue of its position as the most widespread and most vital industry of the country. Agriculture and the mechanic arts occupy an equal position in the act of 1862, but as a matter of history it was agriculture which carried to victory the common cause of all industrial education.

The distinctive work of the land-grant college was in the beginning of a low grade, and should be classed as industrial rather than technical education. This was largely due to the lack of proper preparatory courses, but the public most interested and many of the college officers were content with this low grade. There was great enthusiasm to lift the farmer and mechanic and to dignify labor. Nearly all the new colleges included manual labor in their courses of study. In a little more than a generation the industrial work in both agriculture and mechanic arts has been lifted to the grade of the literary college courses. In other words, the industrial courses of the sixties have developed into technical courses, and the third step in the evolution of the act of 1862 is this broadening and strengthening of the industrial courses.

When the act of 1862 was passed there were in the United States less than a dozen schools that could be termed, even by a liberal construction, schools of technology, and of these only a few would rank with the average technical school of to-day. Electrical engineering was absolutely unknown; mechanical engineering was at its very beginning. Civil engineers usually obtained their training in the employ of other engineers, and, with few exceptions, they were ranked only a little above the expert mechanic. The few engineers who held acknowledged rank with the learned professions gained their place just as a few great naturalists held the same rank, by virtue of great personal ability and attainments, and they were regarded as the exceptions in large classes which, as classes, deserved an inferior rank. It would be a waste of time to portray the change. Engineering is the acknowledged peer of the most dignified professions. It is through this change that the real elevation of the dignity of labor has been asserted. Our fathers, perceiving that all industries were interdependent and that some of the humblest were among the most clearly essential to the general welfare, aspired to lift the work of the artisan to the plane of dignity assigned to the professions. They dreamt of the time when the laboring man and the professional man would include in the preparation for their work similar mental training; when the laborer, earning his bread by the sweat of his brow, would be the social peer of the intellectual worker. It was a kindly dream, but not to be realized. What the colleges have done to raise the dignity of labor has been accomplished in an unexpected way. Brawn will never possess the dignity of brain, and the manual laborer, however important to the general welfare, can never obtain the place of honor which the world accords to intellectual labor; but the technical colleges, by demonstrating how useful, as the thinkers and leaders of our great industries, are the men trained in the most rigid courses of the best colleges and universities, have conferred upon business and upon all industry a dignity which sometimes equals, or even excels, that of the learned professions. Every age grants its highest rewards to that class of citizens which it prizes most highly. The man who occupied the great place among primitive men was the strong man who, by brute power, was able to overcome his competitors. With the growth of civilization the warrior who developed physical prowess into the art and skill of soldiery became the favorite and reaped the world's best rewards. In turn, the priest, the statesman, the lawyer have been the world's favorites, and in every age society has given its approval in the way of money rewards. The man whom the age regards as the most necessary is likely to be its richest man. If this test be a correct one, then the man of affairs, who has been trained, not to the work of the learned professions, but to service as a captain of industry, or commerce, or finance, is the favorite of our own time. As the training of such is one of the two distinctive features of the institutions which we represent, I have no shadow of doubt that the importance of this work will increase rapidly with the coming years, placing upon these institutions an increasing burden of responsibility, and according them a constant increase of dignity and public favor.

This, then, is the first great thing to be placed to the credit of these institutions. That, starting with education for a single industry, they have passed from the narrow and particular to the broad and general, developing into industrial education, and finally blossoming into technical education or the higher education as a preparation for all the duties of the day.

The service to technical education is scarcely, if at all, more important than the service of the colleges in developing an understanding of the right and responsibility of the State in higher education. In the act of 1862 we have the first complete and general recognition of the right and duty of the people to provide for the higher education. The act involved not only endowments from the General Government, but it required from each State the assent to this endowment, and almost of necessity involved financial aid from the State government.

When the land-grant act was enacted there were many parts of our country in which the majority of the people were opposed to higher education by the State. It is quite possible that this opposition would have induced some of the States to reject the land grant but for the Anglo-Saxon passion for getting things. Even this might not have been sufficient had the new cause not presented itself in a concrete and restricted form. Many of those opposed to the appropriation of State funds for higher education comforted themselves with the belief that the United States' gift would be sufficient for the needs of the new college, and would render any State appropriation unnecessary. Others were overcome by their interest in agriculture, and hoped to make a concession to one or two industries without sacrificing their principle. But the State that accepted the land grant was logically committed to the principle that the State may provide higher education of any form. Higher education by State funds, once begun, knows no logical stopping point. It may be urged very fairly that the land-grant act did not determine this principle, because it was involved in the establishment of free common schools and high schools. But the establishment of the land-grant colleges was immensely important, because the arbitrary line between the high school and college was a barrier beyond which the State education could otherwise have passed with difficulty. It is a great result of the land-grant college to have asserted and established the doctrine that education in all its forms, from the lowest to the highest, is a State function in which the State has the fullest rights and for which it must bear responsibility, sharing the privilege and responsibility with private corporations only as it thinks best. No more inspiring words were ever uttered in regard to education than these from Emerson, which I regard as worthy of constant iteration by the State colleges and universities. He says:

"I praise New England, because it is the country in the world where is the freest expenditure for education. We have already taken, at the planting of the colonies (for aught I know, for the first time in the world), the initial step, which for its importance might have been resisted as the most radical of revolutions, thus deciding at the start the destiny of this country; this, namely, that the poor man, whom the law does not allow to take an ear of corn when starving nor a pair of shoes for his freezing feet, is allowed to put his hand into the pocket of the rich and say: 'You shall educate me; not as you will, but as I will; not alone in the elements, but, by further provision, in the languages, in sciences, in the useful and in the elegant arts.' The child shall be taken up by the State and taught, at the public cost, the rudiments of knowledge and, at last, the ripest results of art and science."

I need not make the argument for State aid to higher education; it is familiar; but I must indulge the opportunity for a few considerations which appeal rather to the spirit than to the logic of the situation.

First, State aid and State control in higher education are, under present conditions, necessary to our national development. Colleges and universities are of nature conservative. Many of the most important reforms in their work have been forced upon them, and, in some cases, have been suggested originally, not by college officers, but by the outside public—often by men not college graduates. The college officer who is most hospitable to new methods is quite likely to be one who has been thrown into close contact with the outside public. It was Justin S. Morrill, the son of a blacksmith, himself a merchant and statesman, whose training was obtained largely in the shop, in the counting house, and in the halls of Congress; a man denied the privileges of the highest education, who stood all his life near enough to the work-a-day world to feel the beating of its pulse; he it was who forced upon higher education the recognition of the great need of education for industrial pursuits. It was James Buchanan, the college graduate, who vetoed the first land-grant act for academic reasons and because it was likely to hurt the cause of higher education. It was Abraham Lincoln, who knew the heart of the common people as well as any American knew it, who rose above scholastic prejudice and signed the act of 1862, opening for the first time the treasury of the nation for the training of the people in all lines of education. I have no desire to criticise the conservatism of the college. But the college ought to be the servant of the people, and must be placed where it can be called upon for the service that the world needs. Had not the General Government and the States provided for the establishment of technical colleges, it is probable that a number of States would be to this day without proper facilities for the education of their children in the lines of industry upon which their life success depends. The slowness of private colleges to provide technical instruction is due to the belief that technical education is inferior to the older forms of education and likely to lower the educational standard, but it is due also to the expense of providing laboratories, equipments, and instructors, an expense greatly beyond that of the older forms of work and quite beyond the means of many private institutions. Even now, notwithstanding the general recognition of technical education and the demand for it, so great that nearly half our college students are pursuing technical and scientific courses; notwithstanding the desire of church institutions to control the education of their adherents, the technical education is still almost entirely in the hands of the State. The great reform in education which resulted in provision for technical courses must be followed by others, which will meet with the same obstacles, theoretical and financial; and the State must maintain a control of higher education, because it is essential to public prosperity that some colleges should do certain work which private institutions, either because they will not or can not, or for both reasons, are not likely to do in a satisfactory way.

In the second place, the people must control the higher education in order that the results of this education may be the property of the people. No one questions the wisdom of such a public institution as West Point. Yet abolish West Point and you will soon have, in private institutions, at least as satisfactory education in military science as could be obtained under similar conditions in agriculture or engineering. At the beginning, the great reason for West Point was the lack of good military schools, but now an incomparably more important reason is the necessity that the military training of our soldiers shall belong—not to them, as their property duly bought and rightfully to be sold in any market—but shall belong to the nation, left as a trust in the keeping of its servants for the good of the people. The military skill of Grant, Sherman, and Dewey is not for them, but is the great possession of the whole people. The people have supplied it and it belongs to them. We recognize already, and in the future shall recognize more completely, that the same ideal ought to apply to the education and training of every man.

Every public service is a public trust, and with the enormous increase of the importance of industrial leaders, it becomes increasingly important that the public should assert in unmistakable terms its possession of the fruits of their education. For this reason it will become more and more necessary to regard education as a great public function. The time may come when the public will take into its control all great public franchises, but these united will not exceed in importance the possessions of the fruits of higher education. The motto of the early private colleges was, ''For the church;'' but the colleges of to-day must have the more comprehensive motto, ''For the people.''

This development of State education is quite in accord with the best aspirations of the old college, and even from the standpoint of our forefathers the new motto, ''For the people'' is better than the old one. The old was intended to teach the brotherhood of the church; the new motto teaches the brotherhood of man. The people give the educated man his training, and to the whole people he owes his service. If he is lifted above his fellows, he is lifted by his fellows, and so we have the best fulfillment of democracy in education, when the man of learning owes his learning, not to his wealth, but to the generosity of the State, and stands in the midst of the people, not as a superior, but as their champion, armed by their hands, to do valiantly, in their behalf.

Even the religious considerations upon which our fathers laid so much stress are not violated by the present conditions. There were—are there still some?—devoted and devout men who feared the State college and the State university as an irreligious force, but they are finding their fear unfounded. The teacher in the State institution is likely to be as real a disciple of the Great Teacher as he who does his work in the private or church institution, and the results, I believe, show that the religious well-being of the student is nowhere safer than in the State college. There conditions are the real ones of the world into which all students must go eventually, and real tests build up robust character. In the olden days our college system was divisive in its religious influence, and though it succeeded in building up the denominations, it was in constant danger of delaying the unity of Christianity. The State system, whatever may be its faults, is a power for Christian union. It brings together, under thoughtful and serious conditions, representatives of all lines of religious thought, and this is done even better than in outside life, because college conditions involve intimate acquaintance, ability, candor, and freedom from active alliances which embarrass action and bias the judgment. It is especially successful in upbuilding brotherliness of feeling and tolerance of opinion, which must be counted among the best of the products of the ''Christian education.'' He who so uses that term ''Christian education'' as to exclude the great schools of the State, seems to show himself not fully possessed of the spirit of the cause which he represents. There is no better Christian education than the democratic, progressive, and brotherly work of the State university.

The statistics of the land-grant colleges show that their temporal interests have kept pace with the developments of the spiritual side. Such institutions exist in each of the States and Territories. Twelve States have two colleges each, one for whites and one for blacks. Massachusetts has an agricultural college and an institute of technology. In 18 States the land-grant institution is the State university. Of 50 institutions for whites all but 5 have been founded since the passage of the act of 1862, and most of them as the result of it. Of the State universities two-thirds enjoy the benefits of the act of 1862. It is one of the merits of State institutions that they furnish a college education at a low expense. This is to a great extent due to the liberality of the General Government and of the States. In every State except 7, tuition is free to residents of the State, and in these 7 the charge is very small except in one case, and this State provides a number of free scholarships. In nearly half the States, the land-grant colleges hold the first place among the colleges of the State for the number of instructors, the number of students, and for income. In nearly half the remaining States they are first in at least one of these items. They have 29 libraries of more than 10,000 volumes, 7 libraries of more than 50,000, and in the aggregate about 1,300,000 volumes. Forty-four institutions have more than 300 students each, 20 more than 500 each, 11 more than 1,000, and 1 nearly 3,500. The aggregate value of equipment, including endowment, exceeds $59,000,000; or if we add the value of annuities capitalized at 4 per cent, the total income becomes

$153,000,000. Eight institutions have a total equipment exceeding $1,000,000 each, and averaging $2,440,000, exclusive of capitalized annuities. In comparing these institutions with others privately endowed, it should be remembered that these receive from the United States alone, annuities amounting to $40,000 each, representing a capital of $1,000,000. These institutions received in the year ended June 30, 1900, from the National Government, $1,894,000; from students, $645,000; from the States, $2,633,000; from invested funds, $1,404,000; from miscellaneous sources, $551,000; making a total of $7,127,000. The largest regular income is $468,000, an amount exceeded by only 7 colleges in the United States. Six other of these institutions have an income exceeding $300,000, 15 in all have more than $100,000.[a] This record can be regarded as little less than marvelous, and promises that in the near future the higher education of the American youth will be largely in the charge of the State. This is made all the more probable from the tendency of endowments upon which private institutions depend to shrink both in capital and income, while appropriations from the treasury of the State have a tendency to increase with the increase of public wealth. What the near future will bring forth we dare not predict.

This record marks the author of the land-grant act as one entitled to a place among the greatest benefactors of the higher education. His immediate purposes, his ideals, and the results accomplished all stir us with inspiration. It is given to few men to inaugurate a movement of such scope and possibilities, and I doubt if it has ever been given to any other man to witness such an outcome to his endeavors as presented itself to Justin S. Morrill when he reviewed the great educational system of which he is the founder. Each year his memory is recalled in nearly three score institutions scattered over the face of the whole land, not one State or Territory missing in the great congress of universities and colleges which do him honor. He lived to see them marshal an army of 26,000 alumni and 29,000 students, officered by nearly 3,000 teachers—an aggregate greater twice over than all the military forces of the United States before the Spanish war.

Not least among the treasured assets of these institutions should be the memory of this modest man. No occasion like this should fail to invoke the help of his honored name or close without some honest tribute to his great work.

He helped to open, beside every river and in the shadow of every mountain, the heavy doors of opportunity, so that now and forever in unending succession the youth of our country find entrance into the land of learning and of usefulness; an army equipped by the people, from the treasury of the rich and from the scanty hoard of the poor, to achieve the victories of peace; and so receiving from all, they learn their duty to all, and shall make the institutions which they represent more and more truly throughout the years, as they are from the people, so also for the people. And this shall be the memorial of a great man. It is a magnificent monument which stands to the east of yonder Capitol, the world's most glorious temple of literature; but a greater memorial are 600 college buildings scattered o'er the face of our whole country. It is a great thing to have laid out the course of financial legislation during nearly half a century; it is one of the greatest things to have blazed out the paths by which half the college men of the future shall climb the heights.

On motion of G. W. Atherton, the thanks of the Association were voted President Harris for his address. President Atherton also offered a resolution requesting the Secretary of Agriculture to print the president's address as a separate pamphlet, which was referred to the executive committee, favorably reported, and adopted.

Morning Session, Wednesday, November 13, 1901.

The convention was called to order at 9 a. m., President Harris in the chair. That part of the report of the executive committee relating to a summer school of agriculture was then taken up.

Summer School of Agriculture.

W. O. Thompson, of Ohio. The movement for a summer school of agriculture took its origin in a report that came from Professor Hunt, dean of the College of Agriculture and Domestic Science, addressed to the president of the Ohio State University, and was by the latter laid before the board of trustees for its approval. A year ago, in New Haven, this communication was presented to this Association. After its presentation there the matter was referred to the executive committee of this body. That committee took action upon the question, as follows:

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[a] These statistics are compiled from Bulletin 97, Office of Experiment Stations, and from the World Almanac and Encyclopedia for 1901.

> The executive committee recommends that the Association approve the suggestion of the Ohio State University that a graduate school of agriculture be held during the summer of 1902, and recommends the acceptance of its offer to furnish the necessary buildings and equipment and to assume the financial responsibility for the session.
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> The committee recommends also that if the success of this session seems to justify the continuation of such a summer school, it be assumed as a cooperative enterprise under the control of this Association, and the following outline plan is submitted as a basis for the discussion of the convention:
>
> "(1) 'A committee of control for the summer school' shall be appointed at each convention to consist of three persons, one of whom shall be the president or some other duly authorized officer of the institution at which the next session is to be held.
>
> "(2) The committee of control shall appoint a dean, and together with the dean, shall appoint the faculty, shall fix the work of the school, and determine the duties, powers, and compensation of the officers of the school.
>
> "(3) The Association, either by itself or in cooperation with the institution at which the next session is to be held, shall make provision each year for the expenses."

Pursuant to this action taken by the executive committee of this body, the local authorities of the State University proceeded to take preliminary steps toward the organization of this summer school; and in doing this we invited Dr. True, of the Office of Experiment Stations, to act as the dean of the summer school, upon the supposition that it would be held the coming summer. After a conference with him at Columbus, it was thought desirable to send out a circular letter to all the colleges and stations and also to send out to individual men inquiries as to what their judgment would be and whether they would be willing to cooperate in the matter. In response to that circular letter we have received replies from a great number of the men interested in agricultural colleges and experiment stations, uniformly speaking with favor and enthusiasm of the project as a thing desirable and necessary.

The carrying out of this project is wholly dependent upon the expression of the colleges and stations, both as to the men who shall do the instructional work and as to the effort to enlist interest on the part of those who are expected to receive the instruction.

The report of the executive committee made here yesterday morning (see p. 20) gives some further light upon the subject. The responses we have received would seem to indicate a general desire that we should go on with this movement; and it has been committed largely to Dr. True and myself to speak at this meeting the final word and to say whether the project shall go on or not, and we have assumed, upon the kindly report made by the executive committee and the favorable responses to our circular and the feeling shown here, that this work ought to go on. Therefore we expect to proceed with this summer school, and we make that announcement here. A detailed announcement of courses of instruction would have to come a little later, after we have consulted with the men who are in a position to give instruction during the summer. There are men who could do it at certain times and could not do it at others. It is expected that if this movement goes on from year to year the corps of instructors will not always be the same, because men able to do the work one year might not be able to do it another year.

I have nothing further to say on this subject now except to give the positive assurance that the school will be in operation next summer at Ohio State University as the first experiment of the kind in this country. We sincerely trust that we shall have the cooperation of everbody who is interested in the undertaking; and if our operations with a view to giving this enterprise a permanent place in the field of agricultural education should prove to be a successful stimulus to the work, its benefits will be manifest and its future will probably be assured.

The Ohio State University committee felt this matter to be of such importance as to justify the university in appropriating money for the expenses of this summer school the first year. We believe that a reasonable amount of money could not be put to a better use than to encourage an enterprise of this sort, believing that it will help us all.

I should be glad if the convention would hear for a few moments Dr. True, who acts as dean of this summer school. If it is desired to ask any questions either of him or of me, we shall be glad to respond.

A. C. True, of the Office of Experiment Stations. Mr. President, I do not know that I can add very much to what has already been said with reference to this summer school.

The matter was talked over at the New Haven convention, and since that time I have made something of a study of the subject, especially recently, since the call came to me to take active part in the movement. As I have looked into the matter and conferred about it with gentlemen representing different institutions, I have been more and more impressed with the desirability of having such an institution as this summer school. I think it is possible in this way to inaugurate a movement which will be of very great importance and value to the general interests of agricultural education and research in this country.

At present we lack a center for discussion, in any thorough way, of problems relating to experiment-station work and to education in agriculture. I take it that a school of this kind, if it succeeds, will bring together a considerable number of educators and investigators of agriculture in this country, and will afford an opportunity for the presentation of newly acquired information to the young men who are just entering upon this work and for the discussion of points that need further investigation and study—an opportunity such as can be offered by no other institution. Certainly there is no place now where there can be such discussion.

The annual meetings of this Association permit these matters to be taken up only in a very brief way. Most of the time of these meetings is occupied in the discussion of questions of general policy.

When we consider the scattered condition of our institutions and the comparative isolation of quite a number of them, I think we must see that it may be a matter of very great importance to bring together men from institutions so widely scattered and have them associated for a time, so that they may come in contact with their fellow-laborers and may receive stimulation and encouragement to better work. This, in my judgment, is the most important thing relating to this summer school.

If this enterprise is to succeed it must, of course, have the hearty and active cooperation of the institutions represented in this body. There is no possibility of its having success under any other condition. So we have hoped that we may enlist this earnest, active cooperation.

The responses to the circulars and the letters that have been sent out have been, in my judgment, very encouraging. In the first place, we seem to be fairly assured of a strong faculty for the school. The next thing is to secure a promise of students in sufficient numbers to warrant the assembling of the faculty. I want to lay it upon your minds and hearts that when you return to your respective institutions you should undertake to explain this matter at home, so that the young men who are graduates of your institutions, or engaged in college and instructional work, may obtain accurate information and may feel that they have your support and encouragement in thinking about the matter. If this be done, I feel sure we shall have a goodly number of students and that the first session of the summer school of agriculture will be a success, so that we shall be able to inaugurate an enterprise which, as the years go on, will develop into a means of greatly strengthening the cause in which we are all so much interested.

E. Davenport, of Illinois. I rise to ask if there has been any thought in regard to a tuition fee to be paid by attending students?

W. O. Thompson. That point has not received consideration at all. The State University of Ohio does not charge anything ordinarily, excepting the registration fee of $6 per term. I have no idea that there will be a charge of anything like that amount in this case. There might be a mere nominal fee of a dollar for registration, but even that has not been decided definitely; and if the sentiment of this Association should be against such a charge, we certainly would not impose it. We shall be very glad to hear the Association express its view on that point.

C. F. Curtiss, of Iowa. In regard to the matter of securing information about the prospective number of students, it seems to me that that would be better obtained after some information has been published about the lines of instruction which will be offered, the faculty to be engaged, and the facilities for instruction. Naturally the young men connected with the various educational institutions—post-graduate students—will want this information as soon as the proposition is presented to them. They will want to know the opportunities and advantages offered.

In the circular three lines of work are specified—stock judging, feeding, and soil physics. I should like to ask whether it is the intention of the committee to confine the instruction to those three lines?

W. O. Thompson. That was merely a suggestion. At the last conference it was thought best to widen the scope there suggested, and in asking men to join in this work, to be governed somewhat by their tastes or predilections. The lines have not been narrowed, but have been somewhat broadened beyond what is printed in the circular.

In reply to the point raised by Professor Curtiss, I will say that when men in charge of this movement come together and agree upon a course of study, we shall address circulars to the graduates of the several colleges; we shall try to reach every graduate as well as the faculty of the different institutions. We shall try to interest graduates of agricultural colleges everywhere.

H. P. Armsby, of Pennsylvania. Mr. President, I notice that the recommendation of the committee is to some extent tentative—depending somewhat on the success of the session next summer. I should like to inquire whether the meeting of the next convention of this Association will be likely to be sufficiently early to complete the arrangements for the second session, if such a session should be desired, or whether it would be best in adopting this report to refer this communication to the executive committee, so that if the session of next summer should be a success we may be in a condition to go forward and make what arrangements may seem necessary for the succeeding summer.

With this purpose in view, Dr. Armsby moved that the recommendations of the executive committee be adopted and that their execution for 1902 be referred to the executive committee, with power to appoint a committee of control and make such provisions for expenses as may seem expedient. The motion prevailed.

Revision of the Constitution.

The president laid before the convention as a special order for the hour the subject of the revision of the constitution, with a statement as to the order of procedure in the consideration of the subject. After considerable discussion of the various amendments proposed, participated in by J. K. Patterson, of Kentucky; W. A. Henry, of Wisconsin; J. L. Snyder, of Michigan; W. M. Beardshear, of Iowa; W. M. Hays, of Minnesota; G. W. Atherton, of Pennsylvania; H. J. Waters, of Missouri, and others, the constitution was revised as follows:

Section 2, under the heading "Sections," was amended to read as follows:

> Each section shall conduct its own proceedings, and shall keep a record of the same, and no action of a section, by resolution or otherwise, shall be valid until the same shall have been ratified by the Association in general session.

Section 2, under the heading "Meetings," was amended to read as follows:

The annual convention of the Association shall comprise general sessions and meetings of the sections, and provision shall be made therefor in the programme. Unless otherwise determined by vote, the Association will meet in general session in the forenoons and evenings of the convention and the sections in the afternoons.

Section 3, under "Officers," was amended to read as follows:

All officers of this Association shall be elected by ballot, upon nominations made upon the floor of the convention, and shall hold office from the close of the convention at which they are elected until their successors shall be chosen.

Section 3, under "Duties of officers," was stricken out, and section 4 (which thus becomes section 3) was amended by striking out that portion beginning "It shall designate the two sections," etc., and substituting in lieu thereof the following:

It shall designate the time and place of the convention; it shall present a well-prepared order of business, of subjects for discussion, and shall provide and arrange for the meetings of the several sections. The subjects provided for consideration by each section at any convention of the Association shall concentrate the deliberations of the sections upon not more than two lines of discussion, which lines as far as possible shall be related. Not more than one-third of the working time of any annual convention of the Association shall be confined to miscellaneous business.

The proviso in the section under "Amendments" was amended to read as follows:

Provided, That notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given at the next preceding annual convention and repeated in the call for the convention.

The constitution as thus amended is as follows:

Constitution of the Association of American Agricultural Colleges and Experiment Stations, as amended at the fifteenth annual convention of the Association.

NAME.

This Association shall be called the Association of American Agricultural Colleges and Experiment Stations.

OBJECT.

The object of this Association shall be the consideration and discussion of all questions pertaining to the successful progress and administration of the colleges and stations included in the Association, and to secure to that end mutual cooperation.

MEMBERSHIP.

(1) Every college established under the act of Congress approved July 2, 1862, or receiving the benefits of the act of Congress approved August 30, 1890, and every agricultural experiment station established under State or Congressional authority, the Bureau of Education of the Department of the Interior, the Department of Agriculture, and the Office of Experiment Stations of the last-named Department, shall be eligible to membership in this Association.

(2) Any institution a member of the Association in full standing may send any number of delegates to the meetings of the Association, but one shall be designated to the Association as the regular representative and voting delegate. The same delegate may represent both a college and a station, but shall cast only one vote in general sessions. Other delegates may be designated by any institution to represent it in specified sections of the Association, but such delegates shall vote only in such sections, and no institution shall be allowed more than one vote in any sectional meeting.

(3) Delegates from other institutions engaged in educational or experimental work in the interest of agriculture or mechanic arts may, by a majority vote, be admitted to conventions of the Association, with all privileges except the right to vote.

(4) In like manner, any person engaged or directly interested in agriculture or mechanic arts who shall attend any convention of this Association may be admitted to similar privileges.

SECTIONS.

(1) The Association shall be organized into sections upon (1) college work; (2) agriculture and chemistry; (3) horticulture and botany; (4) entomology; (5) mechanic

arts. The executive committee shall, upon the request of any ten institutions represented in the Association, provide for the organization of provisional sections at any convention.

(2) Each section shall conduct its own proceedings, and shall keep a record of the same, and no action of a section, by resolution or otherwise, shall be valid until the same shall have been ratified by the Association in general session.

MEETINGS.

(1) This Association shall hold at least one meeting in every calendar year, to be designated as the annual convention of the Association. Special meetings may be held at other times, upon the call of the executive committee, for purposes to be specified in the call.

(2) The annual convention of the Association shall comprise general sessions and meetings of the sections, and provision shall be made therefor in the programme. Unless otherwise determined by vote, the Association will meet in general session in the forenoons and evenings of the convention and the sections in the afternoons.

OFFICERS.

(1) The general officers of this Association shall be a president, five vice-presidents, a bibliographer, and a secretary, who shall also be treasurer. The president, junior ex-president, the secretary, and four persons to be chosen by the Association shall constitute an executive committee, which shall elect its own chairman.

(2) Each section shall, by ballot, nominate to the Association in general session for its action, a chairman and a secretary for such section.

(3) All officers of this Association shall be elected by ballot upon nomination made upon floor of the convention and shall hold office from the close of the convention at which they are elected until their successors shall be chosen.

(4) Any person being an accredited delegate to an annual meeting of the Association, or an officer of an institution which is a member of the Association in full standing at the time of election, shall be eligible to office.

DUTIES OF OFFICERS.

(1) The officers of the Association shall perform the duties which usually devolve upon their respective offices.

(2) The president shall deliver an address at the annual convention before the Association in general session.

(3) The executive committee shall determine the time and place of the annual conventions and other meetings of the Association, and shall, between such conventions and meetings, act for the Association in all matters of business. It shall issue its call for the annual conventions of the Association not less than sixty days before the date on which they are to be held, and for special meetings not less than ten days before such date. It shall be charged with the general arrangements and conduct of all meetings called by it. It shall designate the time and place of the convention; it shall present a well-prepared order of business—of subjects for discussion—and shall provide and arrange for the meetings of the several sections. The subjects provided for consideration by each section at any convention of the Association shall concentrate the deliberations of the sections upon not more than two lines of discussion, which lines as far as possible shall be related. Not more than one-third of the working time of any annual convention of the Association shall be confined to miscellaneous business.

FINANCES.

At every annual convention the Association, in general session, shall provide for obtaining the funds necessary for its legitimate expenses, and may, by appropriate action, call for contributions upon the several institutions eligible to membership; and no institution shall be entitled to representation or participation in the benefits of the Association unless such institution shall have made the designated contribution for the year previous to that in and for which such question of privilege shall arise, or shall have had said payment remitted by the unanimous vote of the executive committee.

AMENDMENTS.

This constitution may be amended at any regular convention of the Association by a two-thirds vote of the delegates present, if the number constitute a quorum: *Pro-*

vided, That notice of any proposed amendment, together with the full text thereof and the name of the mover, shall have been given at the next preceding annual convention and repeated in the call for the convention. Every such proposition of amendment shall be subject to modification or amendment in the same manner as other propositions, and the final vote on the adoption or rejection shall be taken by yeas and nays of the institutions then and there represented.

RULES OF ORDER.

(1) The executive committee shall be charged with the order of business, subject to special action of the convention, and this committee may report at any time.

(2) All business or topics proposed for discussion and all resolutions submitted for consideration of the convention shall be read and then referred, without debate, to the executive committee, to be assigned positions on the programme.

(3) Speakers invited to open discussion shall be entitled to twenty minutes each.

(4) In general discussions the ten-minute rule shall be enforced.

(5) No speaker shall be recognized a second time on any one subject while any delegate who has not spoken thereon desires to do so.

(6) The hours of meeting and adjournment adopted with the general programme shall be closely observed, unless changed by a two-thirds vote of delegates present.

(7) The presiding officer shall enforce the parliamentary rules usual in such assemblies and not inconsistent with the foregoing.

Evening Session, Wednesday, November 13, 1901.

The convention was called to order at 7.30 p. m., President Harris in the chair.

Report of Section on Horticulture and Botany.

The report of this section, prepared by L. R. Jones, of Vermont, chairman of the section, was read as follows:

It is with some misgiving that I undertake this report, realizing that if it deals with generalities it will lose interest and possible value for those most concerned in the work, and if it enters upon details it will be impossible to compress them into brief enough space.

I assume that for most statistical matter the members of the Association will prefer to turn to the organization lists and other bulletins of the Office of Experiment Stations. It has seemed to me, therefore, that I could make this report most valuable by striving to present merely a summary of the more important tendencies along educational and investigational lines respectively, to record evidences of general progress, and perhaps to call attention to some hindrances to such progress which are of general occurrence.

As a basis for such report certain questions were addressed to the horticulturists and botanists of the various colleges and stations. Replies were received from most institutions, and the following discussion is based upon these in considerable measure.

We will first briefly note the more important facts concerning—

AGRICULTURAL COLLEGE WORK.

(1) All changes reported in organization or equipment were in the nature of improvements. The most important of these are the creation of a new department of work in each of three institutions, and the erection of new buildings in seven institutions. The year seems to have been especially one of building.

(2) In about 60 per cent of the colleges reporting there is a decided tendency to strengthen the work in the advanced or graduate courses, as compared with the elementary courses, and in at least two of the colleges there are several men working for the doctor's degree upon problems in horticulture or economic botany.

(3) The tendencies in the advanced undergraduate courses and in the graduate work are naturally varied, but in all cases they seem to aim at a direct and intensive preparation to meet regional problems; thus in the South and Southwest there is mention of canning, and of the physiology of the cotton plant; in the Middle West of fruit growing, especially orchard and nursery work; in the North of forestry; while in many places plant physiology is being developed as fundamental to a scientific consideration of methods in plant culture, breeding, or pathology.

(4) Most encouraging reports come from all parts of the country as to the urgent and rapidly increasing demands for college men who have specially fitted themselves in economic botany and horticulture. The statement is sent from many States, east, west, north, and south alike, that the demand for such men for farm or garden superintendents, fruit growers, nursery men, foresters, scientific teachers, and investigators is greater than the supply. I will quote a few sentences:

"We have not been able to supply the demand for specialists in horticulture."—Indiana.

"The opening in this line [nurseries and commercial fruit growing] is almost unlimited."—Iowa.

"The demand for men in nurseries, greenhouses, and commercial fruit growing is increasing."—Kansas.

"An increasing demand during the past year for men trained in agricultural botany."—Massachusetts.

"Demand for college-trained men is greatly increasing, and we have difficulty in furnishing enough of them."—Minnesota.

"Demand for competent men to superintend large fruit interests is increasing and is greater than the supply."—Missouri.

"This demand through the South [for men trained in botany and horticulture as teachers in industrial schools] is on the increase."—Tennessee.

"The demands are increasing rapidly" [for college men for nursery work, fruit farming, etc.].—Texas.

"Demand for men well trained in horticulture and economic botany has steadily increased and we are entirely unable to supply as many as are asked for."—Vermont.

"Have had during the past year or two far greater demand for properly trained men than we could supply."—Virginia.

In this connection mention should be made of the increasingly large number of our best graduates who are availing themselves of the splendid opportunities offered by the Department of Agriculture to its scientific aids. This has already stimulated the students in our land-grant colleges to a higher grade of work and will rapidly develop a body of young men well trained for work in the laboratories and lecture rooms of the stations and colleges as well as in Government service.

EXPERIMENT STATION WORK.

The statements regarding improvements in equipment, new buildings, etc., made under the previous head apply in general to the experiment station as well as to the college departments.

There seems to have been but little change as compared with previous years in the amount of time given to investigation or to the running expenses in the various institutions which have sent reports. It would seem at first thought, therefore, that the educational work is increasing relatively faster than the investigation. This inference is not quite a fair one, however, since the investigations of advanced students in many of our colleges are made upon experiment station problems.

But few radical changes are reported in the nature of the lines of investigation, but there are evidences of certain strong tendencies, as follows:

(1) More attention to bacteriology in relation to plant diseases and to soils.

(2) More attention to normal physiology of economic plants as fundamental to scientific methods of plant culture and to the understanding of plant diseases and their prevention.

(3) More attention to the selecting and breeding of hardy, disease-resistant varieties as contrasted with miscellaneous variety testing.

THE RELATIONS OF COLLEGE AND STATION WORK.

Any consideration of the progress of the college and station work involves that of the mutual relations of the two. It is realized that the problem in so far as it is a general one properly rests with our executive officers, especially with the college presidents and station directors. But it is quite evident that there can be no one general solution of such a problem. Each institution and each department in each institution must solve the problem for itself. It may not seem improper, therefore, to contribute such report as we can of the progress of botanists and horticulturists toward its solution.

Concerning those few institutions where the work is exclusively educational or investigational we have no report to make other than that all parties seem content.

In those institutions where station and college are combined there seems to be no general tendency or desire to separate the station and the college work by making them distinct departments. There are but few cases where this has occurred and but few others where it is contemplated. In the majority of cases it is considered preferable to continue as at present with the same man at the head of both college and station work. The arguments for this are varied, the chief being unity, harmony, and economy. It is, however, becoming each year more evident that, as a rule, one man can not serve the two masters equally well. If he is to succeed best he must devote his time chiefly to college or chiefly to station work, or else so arrange his work that most of his college duties can be performed during one portion of the year and most of his station investigations during another portion. As a result, it is becoming a common practice to furnish the head of each department with one or more assistants. In such cases, where the best results have been reported to us, the head of the department has decided whether he can most advantageously give his chief attention to college or to station duties. In most cases the college work has the first claim on his time. The assistant or the first assistant, if there is more than one, is then employed exclusively for the work in the other institution, in most cases, therefore, for the station. A second assistant may be employed exclusively for college work in case three men are needed. For really satisfactory results under this system it is necessary that the first assistant be a well-trained man and paid a salary that will retain his services for at least three years. In a few cases, where the college work is light, the plan is reversed and the head of the department gives most of his time to investigation work. Such a condition is exceptional, however, where the college department is well developed. A marked advantage from such an arrangement with one or more assistants is that it permits the more readily of the absence for study or investigation of either the head of the department or of the assistant for considerable periods of time without the complete interruption of the work. It is noteworthy that an unusually large number of our horticulturists and botanists spent a portion of the last year in study and investigation either abroad or at Washington or some other educational center in this country.

L. R. Jones, *Chairman.*

On motion, the report was received.

Graduate Study at Washington.

C. Northrop, of Minnesota, submitted the following report on this subject:

The committee on graduate work respectfully reports that no progress in securing a bureau in Washington for the administration of graduate work by students of our colleges has been made since the last convention.

A private association has been incorporated in the city of Washington, the object of which is said to be the opening to students, in an orderly way, of the scientific and other material in Washington; and it is probable that individual students may be aided to secure access to public documents and scientific collections, by this private association. But, in the judgment of your committee, the Association of Agricultural Colleges and Experiment Stations is not prepared to take any action in reference to this private association until its purposes and plans are more clearly formulated.

Cyrus Northrop, *Chairman.*

On motion, the report was received. (See also p. 55.)

Military Instruction in Colleges.

G. W. Atherton, of Pennsylvania. I am sorry to say, Mr. President, that the committee on this subject has no formal report to make. The idea that was in the mind of the Association, or at least in the minds of members who were interested in securing the appointment of the committee, was that in some way, in view of the enlarged demand for military and naval service, the institutions represented here might be brought into some kind of association with the West Point and Annapolis academies, so that the military instruction we are required by law to give, and the engineering instruction which we are in fact giving, might be made useful to those two great branches of the Government service.

The committee has once before reported to the Association its very satisfactory and gratifying interview with Secretary Root, who promised to give consideration to any such matter as we might present. Just at that time, however, the Secretary of War had appointed a commission, with General Ludlow, I believe, at its head, to present a scheme for the reorganization of instruction at West Point, and for the establishment of a graduate school or college. The committee felt that it would hardly be wise to undertake to formulate any scheme, or even to investigate in reference to the formulation of any scheme of affiliation between our colleges and the naval and military academies of the Government, until those questions pending in the War Department should be settled. In addition to that, no member of the committee has found time to take up the subject in so thoroughgoing a way as it ought to be entered upon.

I think we must in the not distant future expect to find these great advances of instruction in our colleges brought in relation to the military and naval service of the Government in such a manner as will open the way for graduates of our institutions. I should have no objection to having the committee discharged; and I am not prepared at the present time to recommend that it be continued. I can only say that, if it be thought wise by the convention to continue it, the matter will be kept under view continually, with the hope that when the opportunity and time come, some practical suggestion may be made.

The report was accepted and the committee continued.

College and Station Exhibit at the St. Louis Exposition.

A. C. True. Mr. President, reference was made in the report of the executive committee to the collective station exhibit, which you will remember was prepared for the Paris Exposition and which since its return to this country has been exhibited at the Buffalo Exposition. It was thought probable at one time that the exhibit would be required for the Charleston Exposition, but it has finally been decided not to send it there, and therefore I presume it will be brought back to Washington in a short time.

There is to be, as you all know, an exposition on a large scale at St. Louis in 1903. If this Association desires to take any steps toward having an exhibit at the St. Louis Exposition, something should be done about the matter at this session of the Association. The Government board for the St. Louis Exposition has already been appointed, and before long questions regarding space and funds will arise, and we should be prepared to meet them, if we desire to take any part in the exposition.

In deciding such matters, I think the precedent established has been to appoint a special committee to canvass the matter and report to the Association. Following that precedent, I move that a special committee of five be appointed by the Chair to consider the advisability of making a collective exhibit of the colleges and experiment stations represented in this Association, and report to the Association at a later meeting.

The motion was agreed to.

The committee subsequently appointed consists of A. C. True, of Washington, D. C.; W. H. Jordan, of New York; A. T. Neale, of Delaware; C. S. Phelps, of Connecticut, and C. F. Curtiss, of Iowa.

For report of this committee see page 59.

Graduate Study in Washington.

A. Cope, of Ohio, introduced the following resolution, which was referred to the executive committee:

Resolved, That the committee on graduate study in Washington be directed to exhaust every effort to devise a plan whereby graduate study and research in the several departments, laboratories, and libraries in Washington of the General Government may be efficiently organized and directed under Government auspices; and, in the meantime, that said committee be requested to secure, if practicable, for the graduate students of the colleges and universities represented in this Association the the same opportunities for study and research in other departments which have already been provided by the Department of Agriculture through the efforts of said committee.

Later, on recommendation of the executive committee, this resolution was adopted.

G. W. Atherton introduced the following resolution, which was received and referred to the executive committee:

> *Resolved*, That the Association of American Agricultural Colleges and Experiment Stations record its appreciation of the action of the Government through the Department of Agriculture, which opened the facilities for research for advanced work at Washington in response to the request of this Association; and further express its desire that these facilities be still further extended, and that it would welcome with satisfaction the development and organization of a national university devoted exclusively to advanced and graduate research.

Later this was adopted on the recommendation of the executive committee.

The delegates to the convention were received by the Secretary of Agriculture at his home from 9 to 11 p. m.

Morning Session, Thursday, November 14, 1901.

The convention was called to order at 9 a. m., President Harris in the chair.

The Beet-Sugar Industry in the United States.

L. G. Carpenter, of Colorado, introduced the following resolution, which was referred to the executive committee:

> Whereas within a few years a new industry, that of making sugar from beets, has gained a foothold in the United States, largely rendered possible through the scientific investigations of the Department of Agriculture and of the experiment stations; and
>
> Whereas such industry promises to be well adapted to the conditions of the United States, and this country will be able to produce within its borders the sugar consumed therein: Therefore, be it
>
> *Resolved*, That we urge upon the President and Congress the benefit to the agricultural interests of fostering this industry as far as consistent with public policy, and of refraining from action, whether directly or indirectly, through arrangements with other countries, which would jeopardize its development.

For discussion and action on this resolution, see page 63.

State Aid to Agricultural Education and Research.

E. B. Voorhees, for the section on Horticulture and Botany, offered the following resolution, which was referred to the executive committee:

> Whereas this Association recognizes that the agricultural colleges and experiment stations have proven a potent influence in the improvement of American agriculture, and that their increased usefulness will be in proportion to the amount of funds at their command: Therefore, be it
>
> *Resolved*, That we earnestly recommend to the respective States that they be liberal in appropriating State funds to care for the increasing number of students desiring instruction and for the widening range of questions pressing for experimental solution.

The executive committee later reported adversely on this resolution, on the ground that it seemed to be an approach to an effort to interfere with State legislation, and it was laid on the table on motion of D. C. Hardy, of Mississippi.

Methods of Teaching Agriculture.

A. C. True submitted the following report from the committee on the methods of teaching agriculture:

> The committee on methods of teaching agriculture submits a sixth report of progress. Since the New Haven convention, the committee has completed the syllabus of the courses in agrotechny, rural engineering, and rural economics. This syllabus was printed in the proceedings of that convention (Bulletin 99 of the Office of Experiment Stations), and also in circular No. 45 of that office. This completes the outline of the college course in agriculture. It is hoped that provision will be

made at this or succeeding conventions of this Association for a further discussion of this course as outlined by your committee.

The committee has also made a survey of the progress of agricultural education in this country during recent years, and has found abundant evidence that the attitude of this Association and the work of this committee as its representative have already borne good fruit in stimulating and aiding the movement for the specialization of agricultural instruction in our colleges, the strengthening of the agricultural faculties, and the bettering of the material equipment for agricultural education. This movement is now well under way and the past year has witnessed a greater and more rapid development along this line than any previous year.

As yet there has been comparatively little development of distinct courses in rural engineering and rural economics in our colleges and universities. Beginnings of such courses have been made at a few institutions. For example, a department of irrigation has recently been established at the University of California and arrangements have been made for special courses in irrigation at the Colorado Agricultural College. There has also been some provision for lectures on agricultural economics at the University of Wisconsin. It is hoped that some of our stronger agricultural institutions will soon take a more active interest in the establishment of courses in rural engineering and rural economics. These subjects embrace matters of great importance to our agriculture, and their serious consideration in our higher institutions for agricultural education may do much to promote the best development of our agriculture. We need to broaden our agricultural courses along these two general lines.

After consultation with the instructors in agriculture in the different colleges, it has seemed well for your committee to undertake to present in some detail information regarding the courses in agriculture and the facilities for instruction in this subject in our colleges. It is especially desirable to put on record data regarding distinctive features of these courses and the materials for demonstration and illustration already existing in different institutions. Your committee has, therefore, undertaken during the present year to collate such information regarding the course in agronomy. Considerable material has already been accumulated, but some time must elapse before it will be in form for publication. Your committee therefore asks that it may be granted leave to print its report on agronomy in our agricultural colleges in whole or in part in the next proceedings of this Association and be given authority to negotiate with the Office of Experiment Stations for the separate publication of its detailed report on this subject.

J. H. Connell,
T. F. Hunt,
A. C. True,
H. T. French,
H. H. Wing,
Committee.

A. C. True explained briefly the purpose and scope of the committee's proposed inquiry into the methods, equipment, and illustrative material for teaching agriculture at the different institutions.

The report was accepted and the committee was given leave to print a more detailed report in the proceedings of the Association if it should so desire.

PURE-FOOD LEGISLATION.

W. A. Withers, of North Carolina, chairman of the committee on pure-food legislation, submitted the following report, which was referred to the executive committee for consideration and further report:

Pure-food legislation has made very rapid progress in recent years. During each year some State, which had not done so previously, has enacted such laws, and no case is on record of the repeal of such a law once enacted. Our Government has made a beginning already in authorizing the inspection of articles of food produced in foreign countries and intended for entry into our ports. This has been followed by legislation authorizing the Secretary of Agriculture, when an application is made to him, to have an inspection made of articles of food intended for shipment to foreign countries. By a still more recent act of Congress the Secretary of Agriculture has been authorized to make investigations as to the harmfulness of added preservatives.

The principle upon which all pure-food legislation depends is found in common law and justice, and no special legislation would be necessary or even desirable were it not for the great difficulty, without the existence of a bureau charged with the inspection, to prove the presence of foreign matter in small amounts and the harmfulness of such matter when present. It has frequently happened where standards have not been fixed, that manufacturers have been punished in one county for selling an article of a certain degree of purity when a manufacturer offering in a neighboring county similar articles of a lower degree of purity went free. The fixing of standards has been recognized by the States exercising food control as best both for the manufacturer and the consumer. Great Britain, following the example of other European countries, has authorized the establishment of standards for certain articles.

In recent years several bills have been introduced in Congress in regard to the subject. The validity of such legislation has been passed upon by the Committee on Interstate Commerce of the Senate and the Committee on Interstate and Foreign Commerce of the House of Representatives. The following organizations, representing the various interests concerned, have adopted resolutions strongly indorsing the enactment of pure-food legislation: The National Grocers' Association, the National Export Association, the Association of State Dairy and Food Commissioners, the National Grange Patrons of Husbandry, and about fifty other organized bodies representing commercial interests.

Proposed legislation has been indorsed by the Senate Committees on Manufactures and Agriculture and Forestry. When the House committee takes favorable action legislation will probably speedily follow, and the prospects for this during the existence of the present Congress are very good.

On account of the close relation between the members of this Association and the agricultural interests your committee would respectfully recommend the adoption of the following resolution, and that the same be placed in the hands of the executive committee for transmission at the proper time to the proper committees of Congress:

Resolved, That the Association of American Agricultural Colleges and Experiment Stations, believing it to be best for the agricultural interests with which its members are intimately associated, as well as for the food manufacturers and consumers, earnestly recommends that Congress enact a national pure-food law and place the execution of the law, the fixing of standards, and other details in the hands of the Secretary of Agriculture.

Respectfully submitted.

W. A. WITHERS,
WM. FREAR,
A. T. NEALE,
H. J. PATTERSON,
H. J. WHEELER,
Committee.

At a later session of the convention the executive committee, through its chairman, reported as follows on this subject:

In the judgment of the committee it is not advisable for this Association to give expression to an opinion on any question of pending legislation except in cases where it has had opportunity to consider and discuss the provisions of a specific bill. But inasmuch as the Association has already considered the general subject through its standing committee on pure-food legislation, the executive committee recommend that the Association reaffirm its former action by adopting the resolution, with an amendment striking out at the end the words, "and place the execution of the law, the fixing of standards, and other details in the hands of the Secretary of Agriculture."

The recommendation of the committee was agreed to.

BREEDING PLANTS AND ANIMALS.

W. M. Hays, of Minnesota, for the committee on animal and plant breeding, submitted the following report:

Your committee respectfully reports progress and asks to be continued, simply as a promoting organization, to bring about cooperation in experimenting, and to arrange for a conference of breeders, biologists, and others who may aid in placing the science and pedagogics of plant and animal breeding on a better footing. A tentative plan has been formulated to secure cooperative researches among groups of animal breeders, of plant breeders, of teachers, and of biologists with a view of having reports submitted at a general conference. Some of the subjects suggested are theories of heredity, the philosophy of herd-book records, the philosophy of stock judging, the philosophy of judging varieties of plants, methods of cooperation in plant improvement, and methods of cooperation in animal improvement. Biologists express delight with an invitation to thus aid in promoting such vast interests as animal and plant production, and your committee believes that the vast resources available in biological laboratories should be employed in the discovery of the best means of developing the largest powers and the economic values inherent in plant and animal organisms.

W. M. HAYS, *Chairman.*

W. M. HAYS. Mr. President, the subjects embraced in this report continue to grow greatly in the minds of the committee and those associated with them. For example, the subject of animal breeding seems to be in a very unsatisfactory pedagogic form in our colleges. The breeding of plants is so comparatively new that it is undertaken by few men; yet everybody is calling for light on that subject. Plant-breeding in a systematic way has been begun in a great many stations, and more especially in the National Department of Agriculture. This committee was formed at the suggestion of the Secretary of Agriculture to bring together the breeders of animals and plants. The object was to have concentrated effort on this subject in a systematic way; that the Department of Agriculture, the experiment stations, the colleges, and the practical breeders of animals and plants outside of these institutions might combine in an effort to bring order out of chaos.

I move, Mr. President, the adoption of this report, and that the president of the convention be instructed to continue the committee.

The motion was agreed to.

Two vacancies in the committee caused by the resignation of H. P. Armsby, of Pennsylvania, and the retirement from station work of A. A. Brigham, of Rhode Island, were later filled by the appointment of C. F. Curtiss, of Iowa, and H. J. Webber, of the Bureau of Plant Industry of the United States Department of Agriculture.

AGRICULTURAL EXHIBITS AT THE ST. LOUIS EXPOSITION.

A. C. TRUE. Last evening there was appointed a committee to consider the desirability of an exhibit at the St. Louis Exposition. This committee has canvassed the matter, and has consulted members of the Association so far as practicable in the time allowed. On behalf of the committee I desire to submit the following report:

Your committee, appointed to consider the desirability of a collective college and experiment station exhibit at the St. Louis Exposition in 1903 and to recommend a plan for its preparation and care, beg leave to report that they have considered carefully the matters referred to them, and are of the opinion:

First. That a collective exhibit at the St. Louis Exposition of the progress of education and research in agriculture in the institutions represented in this Association is desirable.

Second. That such an exhibit is practicable provided the Association can obtain from the Office of Experiment Stations assistance in the preparation and care of the exhibit and in the payment of the expenses upon a plan like that on which the exhibit for the Paris Exposition was prepared, and your committee recommend:

(1) That a special committee of five persons be appointed, of whom the Director of the Office of Experiment Stations shall be one, to confer with the honorable Secretary of Agriculture with a view to determining what assistance the Department of Agriculture will give, and if it is found feasible, to prepare the exhibit.

(2) That the executive committee be instructed to pay the necessary expenses of the special committee.

A. C. TRUE,
W. H. JORDAN,
A. T. NEALE,
C. S. PHELPS,
C. F. CURTISS,
Committee.

A. C. TRUE. Mr. President, this report if adopted will involve the preparation of an exhibit which will illustrate the progress in agriculture both in the way of education and research. In this respect it will differ from the exhibit at the Paris Exposition, in which only the experimentation side of this work was shown. It has been thought best in presenting this report to advocate that only education in agriculture should be exhibited by this Association, and that no attempt should be made to exhibit the work of the colleges in a more general way. In connection with the Paris exhibits there was some criticism because nothing was shown regarding the progress of education in agriculture; and it is thought that it will increase the interest in the exhibit and make it more useful if education as well as research can be shown.

The plan hitherto adopted in making these collective exhibits has been for the different institutions to furnish the material for the exhibit and pay whatever expenses are incurred in the preparation of this material. The Department of Agriculture has then taken this material, after it has been arranged by the committee of the Association, and has transported, installed, and cared for it in connection with the exhibit, paying the expenses thus incurred. This is the plan proposed in this report.

I move that the report be adopted.

J. K. Patterson, of Kentucky, moved to amend the first clause of the report by inserting, after the word "agriculture," the words "and in the mechanic arts;" so as to read:

> That a collective exhibit at the St. Louis Exposition of the progress of education and research in agriculture and in the mechanic arts in the institutions represented in this Association is desirable.

After some discussion, participated in by A. C. True, H. E. Alvord, H. P. Armsby, H. J. Waters, J. K. Patterson, and L. G. Carpenter, the amendment was voted on and lost.

The question being then taken on adopting the report of the committee, it was agreed to.

The committee appointed in conformity with the recommendations of this report consists of W. H. Jordan, of New York; H. J. Waters, of Missouri; C. F. Curtiss, of Iowa; W. M. Hays, of Minnesota; T. F. Hunt, of Ohio, and A. C. True, of the Office of Experiment Stations.

W. E. Stone, of Indiana, moved that a committee be appointed by the chair to consider the advisability, the methods, and the ways and means for securing and carrying through an exhibit at the St. Louis Exposition, setting forth the progress and extent of education and investigation in mechanic arts in the land-grant colleges of the United States; and that the executive committee of the Association be authorized to provide for the expenses of the committee.

The motion prevailed.

The committee appointed by the chair to have charge of this matter consists of W. E. Stone, of Indiana, chairman; J. H. Washburn, of Rhode Island; and J. K. Patterson, of Kentucky.

COOPERATION BETWEEN THE STATIONS AND THE UNITED STATES DEPARTMENT OF AGRICULTURE.

E. A. Bryan, of Washington, from the committee on cooperation between the stations and the Department of Agriculture, submitted the following report:

> Your committee on cooperation between the stations and the Department of Agriculture would respectfully submit the following report as supplementary to the report of one year ago:
>
> A year of reflection and observation has strongly confirmed your committee in the belief that the principles for guidance in cooperation between the stations and the

Department of Agriculture which were embodied in your committee's report one year ago and adopted by the Association are substantially correct. Very satisfactory progress has been made during the year in systematizing cooperation. While it is perhaps unnecessary to add anything to the previous statement of principles, yet a little fuller explanation may not be inadvisable; and your committee would therefore add the following recommendations.

First. When cooperation is desired by the station, it is deemed advisable that the proposal for such cooperation be made to the Department by the director of the experiment station. Where, on the other hand, the Department desires cooperation of the station, it is deemed advisable that the proposal be made in the first instance to the director rather than to a member of his staff.

Second. While it is well understood that no financial obligations can be undertaken beyond the end of the fiscal year, yet it should be recognized that any arrangement for joint experimentation which requires some years to complete creates a moral obligation upon both parties to carry the work to a conclusion.

Third. When a line of investigation has been in progress in any State under the auspices of either institution, it is, as a rule, unwise for the other party to undertake, independently, the same line of investigation, at least until after full consultation upon the subject.

Respectfully submitted.

W. A. Henry.
H. J. Waters.
L. G. Carpenter.
E. A. Bryan.
H. H. Goodell.

The report was laid on the table temporarily. For discussion of it see page 62.

Election of Officers.

The following officers of the Association for the ensuing year were elected by ballot upon nomination made upon the floor of the convention as prescribed in the amended constitution:

President.—W. M. Liggett, of Minnesota.

Vice-presidents.—W. O. Thompson, of Ohio; H. J. Waters, of Missouri; J. H. Washburn, of Rhode Island; J. H. Worst, of North Dakota; J. C. Hardy, of Mississippi.

Secretary and treasurer.—E. B. Voorhees, of New Jersey.

Bibliographer.—A. C. True, of Washington, D. C.

Executive committee.—H. H. Goodell, of Massachusetts; G. W. Atherton, of Pennsylvania; Alexis Cope, of Ohio; H. C. White, of Georgia.

New Building for Department of Agriculture.

W. A. Henry, of Wisconsin, introduced the following resolution; which was referred to the executive committee:

Whereas the United States Department of Agriculture has long since outgrown the single building originally provided for its special use; and

Whereas this Department has accomplished unmeasured good in the advancement of agriculture in these United States; and

Whereas this division of Government service has been appropriately recognized by advancing its chief officer to the high position of member of the President's Cabinet: Therefore, be it

Resolved by the Association of American Agricultural Colleges and Experiment Stations, in convention assembled, That we urge upon Congress the necessity and wisdom of providing a building for the accommodation of the Department of Agriculture which in magnitude shall be sufficient to amply accommodate for decades to come the still expanding divisions of departmental effort, and which shall properly represent in its architecture the enormous importance of agriculture in this country, and which shall constitute a worthy member of the Government's collection of buildings in this the capital city of the United States.

Resolved, That the secretary of this Association be directed to forward a copy of these resolutions to the Hon. James Wilson, Secretary of Agriculture, and to the presiding officers of both the legislative branches of the Government.

On recommendation of the executive committee the resolution was adopted.

MEETING PLACE OF NEXT CONVENTION.

The Association was invited to hold the next convention at the Ohio State University, by W. O. Thompson; at the New York Experiment Stations, by W. H. Jordan; and at the Illinois State University, by E. Davenport. These invitations were referred to the executive committee.

COOPERATION BETWEEN STATIONS AND THE DEPARTMENT OF AGRICULTURE.

On motion, the report on this subject (see p. 60) was taken from the table and read.

B. T. GALLOWAY, of the United States Department of Agriculture. Mr. President, there is very little that I can say upon this matter in addition to what has been reported by the committee. I can only add that the Department, so far as I represent it, agrees with the statement set forth in the report; and it might be well to review briefly some of the progress made during the past year.

We are now cooperating, I think, with possibly 25 or 30 stations in different parts of the country. Of course, many questions connected with this subject have not yet been settled; but we are working out some of the more difficult questions, and I believe it is only a matter of time when we shall be able to carry through this work in a very successful way.

I have no doubt that my colleagues in the Department will fully agree with me in saying that cooperation in the future is bound to be one of the essential features in all our work; and whatever we may undertake to do in connection with the stations, we want to be done, of course, with the clear understanding that it is to be of mutual benefit.

The point made that all matters connected with this subject be first discussed with the leading officers of either the stations or the Department, is, I think, a good one. We are endeavoring wherever possible to carry out that idea. In getting men out into the field, occasions will of course arise when some statements will be made to officers of the stations without first consulting the director; but it is not our intention to show any discourtesy toward the directors in these matters. Such things will necessarily happen once in a while. Our policy has been in the past year, and shall be in the future, to inaugurate all this work by first opening negotiations with the directors. After that is arranged, it is highly important and essential that the main features of the work shall be carried out by the men directly. Of course any complications which may arise from not observing this matter may lead to serious difficulty, as was pointed out the other day.

There is another matter which might be referred to in this connection; that is the fact that, as it seems to us, we must be in our future work with the stations dependent largely on grouping, as far as possible, our lines of investigation. With this end in view, better results, I think, will come through coordination of the work of different stations in such a way that we may make one station, perhaps, a central agency and let that station, through possibly some officers of the station, properly unify the work in such a manner that it will bring the best attainable results from the expenditure of time and money that may be made.

There are, of course, many details which will be worked out, such as the handling of our men, how they are to be engaged, and many other questions that may properly be considered; but it is unnecessary, I think, to dwell on such matters here; so far as necessary they will perhaps be brought out in the course of the discussion.

The report of the committee (see p. 60) was accepted.

E. R. NICHOLS, of Kansas. Mr. President, it seems to me that this committee on cooperation should have a representative from the United States Department of Agriculture. I therefore move that the present committee be continued, with the addition of another member representing this Department.

This was agreed to. The additional member appointed was B. T. Galloway, chief of the Bureau of Plant Industry.

INCREASE IN MEMBERSHIP DUES.

H. P. ARMSBY. Mr. President, the Association at this session has provided for two special committees with reference to the possibility of exhibits at the St. Louis fair, and has instructed the executive committee to pay the expenses of these special committees. It is well known that important legislation is pending in Congress which would be likely to require the presence in Washington of members of the executive committee, or other persons interested in the work of this Association, to a considerable extent during the coming winter. All this will require a considerable expenditure on the part of the Association. I therefore move that the dues for the ensuing year be fixed at $15 for each institution represented in the Association.

The motion was agreed to.

EVENING SESSION, THURSDAY, NOVEMBER 14, 1901.

The convention reassembled at 7.30 p. m. in the Red Parlor of the Ebbitt House, and was called to order by President Harris.

NOMINATION AND ELECTION OF SECTION OFFICERS.

Nominations for officers of sections were presented, as follows:

Section on Entomology: For chairman, F. M. Webster, of Ohio; secretary, H. E. Summers, of Iowa.

Section on Mechanic Arts: For chairman, H. W. Tyler, of Massachusetts; secretary, F. P. Anderson, of Kentucky.

Section on Agriculture and Chemistry: For chairman, H. J. Waters, of Missouri; secretary, C. G. Hopkins, of Illinois.

Section on College Work: For chairman, J. L. Snyder, of Michigan; secretary, W. E. Stone, of Indiana.

Section on Horticulture and Botany: For chairman, J. Craig, of New York; secretary, A. Nelson, of Wyoming.

The secretary was instructed to cast the vote of the Association for the section officers named.

BEET-SUGAR INDUSTRY.

H. H. Goodell, reporting for the executive committee on the preamble and resolution on this subject, introduced by L. G. Carpenter, of Colorado (see p. 56), recommended the adoption of the resolution in the following amended form:

> Whereas within a few years a new industry, that of making sugar from beets, has gained foothold in the United States, largely rendered possible through the scientific investigations of the Department of Agriculture and of the experiment stations; and
>
> Whereas such industry promises to be well adapted to the conditions of the United States, and this country will be able to produce within its borders the sugar consumed therein: Therefore, be it
>
> *Resolved*, That we urge upon the authorities concerned the benefits to the agricultural interests of fostering this, among other agricultural industries, as far as consistent with public policy.

In other words, the resolution as proposed to be amended substitutes for the words "urge upon the President and the Congress" the words "urge upon the authorities concerned;" and strikes out the concluding words of the resolution, "and of refraining from action, whether directly or indirectly, through arrangements with other countries which should jeopardize its development."

J. L. Snyder, of Michigan, and L. G. Carpenter, of Colorado, spoke in favor of the original resolution, and G. W. Atherton, of Pennsylvania, explained the motives which actuated the executive committee in proposing the amended form.

The amended resolution was adopted.

ADVISORY COMMITTEE ON PROGRAMME.

H. H. Goodell, for the executive committee, presented the following resolution and moved its adoption:

With a view to lighten the labors of the executive committee and to secure greater interest in the discussions of the convention of the Association—

Resolved, That the executive committee be authorized to appoint, subject to the approval of the convention, an advisory committee on programme, whose duty it shall be to propose a programme of topics to be discussed in general or sectional meetings at the next annual convention, to secure presentation of appropriate papers and engagement of suitable speakers, under the provisions of the constitution and by-laws of the Association, said programme to be submitted to the executive committee for approval and distribution at least ninety days in advance of the annual meeting.

J. L. Snyder, of Michigan, opposed a change at this time in the method of preparing the programme.

J. H. Washburn, of Rhode Island, explained the desirability of lightening the work of the executive committee.

H. H. Goodell said: I fear that the Association does not quite understand what this proposition means. This refers simply to the programmes of the sections. The by-laws require the chairman and secretary of each section to make out a programme to be sent to the executive committee sixty days, I think, before the annual meeting. The object of the present proposition is to get over the difficulties which have arisen in connection with that matter. These reports from the different sections in many cases either do not come to us or do not come promptly enough. It will be observed that the programme for this meeting includes a programme for the Section on Agriculture and Chemistry, a programme for the Section on College Work, and a provisional programme, which did not begin to cover the ground, for the Section on Entomology. Now, the idea of the executive committee in this proposition was that an advisory committee, if you may so call it, should be appointed—a preliminary committee—so that if the chairman or secretary of any section should not perform the duty of preparing a programme, some individual member of the section should take the matter in hand and make out one. The executive committee does not feel able to make out programmes for the different sections.

It is to the interest of the Association to get a well-ordered programme for each section. This does not apply to the general sessions of the convention, but simply to the business of the different sections.

The resolution was adopted.

On recommendation of the executive committee the following were named as members of the committee: E. A. Bryan, of Washington; W. H. Jordan, of New York; H. W. Tyler, of Massachusetts; C. E. Thorne, of Ohio; and H. T. Fernald, of Massachusetts.

NOMENCLATURE OF ENERGY IN FOOD, ETC.

The following recommendations from the section on agriculture and chemistry were presented by H. J. Waters:

At the meeting of the Association a year ago a committee was appointed by the Section of Agriculture and Chemistry to consider and recommend terms for use in discussions of energy in food and in the bodily economy. The function was similar to that of the committee on nomenclature, which has served the Association so acceptably, though in this case the nomenclature was confined to a very special subject. The members of the committee were W. O. Atwater, H. P. Armsby, and W. H. Jordan. They presented a report of progress at the meeting of the Section of Agriculture and Chemistry yesterday. This included a specific recommendation which the section adopted, and now presents to the Association with the recommendation that it be adopted by the Association as a whole, in the same way as recommendations by the previous and more general committee on nomenclature have been adopted.

It should be added that the report does not cover the whole of the subject, and the committee was requested by the section to make further recommendations at a later time. It may also be of interest to state that the three members of the committee, each of whom has given considerable attention to this subject, were entirely in accord regarding the principles and conclusions upon which the report is based.

The recommendations, as stated by the committee and approved by the section, are subjoined.

For the present your committee recommends the use of terms with significations as follows:

NUTRIENTS OF FOOD.

Total nutrients.—The total amount of nutrients in the given food material.

Available nutrients.—The total nutrients less the intestinal excreta, the latter including both the undigested portions of the food and the metabolic products.

To the ingredients thus called available the term digestible is commonly applied, but the actual digestible portion is represented by the amount which remains after subtracting the undigestible residue of the food from the total nutrients and which thus includes the metabolic products. By the usage here recommended, therefore, the available nutrients are the actually digestible nutrients less the metabolic products. In so far as intestinal gases are concerned in these quantitative estimates, they may be classed with the solid intestinal excreta.

ENERGY OF FOOD.

In general, the total heat of combustion with oxygen, or heat of oxidation of food materials, is taken as the measure of their energy. The same is true of the energy of the unoxidized constituents of the excreta.

Total energy.—The heat of combustion of nutrients.

The available energy.—The total energy, less the heat of combustion of the intestinal and renal excreta, i. e., the potential energy of the total food, less that of (1) the combustible portions of the undigested food residue, metabolic products, and gases excreted by the intestines; and (2) the combustible matter excreted by the kidneys.

What is called available energy is often, and very properly, designated as the gross available energy, but for common use the shorter term available is here proposed.

Net energy.—The energy which remains after subtracting the energy required for digestion[a] from the available energy. This is sometimes, and very properly, called net available energy, but for ordinary use the simpler term *net* is recommended.

Fuel value.—The available energy of the food may be taken as representing the physiological fuel value. Accordingly it is recommended that in discussing the energy of food the term fuel value be used as equivalent to available energy, as above defined.

ENERGY OF BODY MATERIAL.

It is recommended that the terms as above defined be also applied to the energy of body material stored or metabolized, in so far as there is occasion for such use.

W. O. Atwater,
H. P. Armsby,
W. H. Jordan,
Committee.

The recommendations were agreed to.

Death of Dr. John A. Myers.

H. P. Armsby submitted the following resolution:

Resolved, That this Association desires to place on record its sense of the loss sustained by the agricultural interests of this country in the death of Dr. John A. Myers, formerly director of the West Virginia Experiment Station.

Resolved, That the secretary be instructed to transmit a copy of this resolution to the widow of the deceased.

The resolution was agreed to by a rising vote.

On motion of L. G. Carpenter the executive committee was instructed to prepare suitable resolutions in regard to the death of former President Fairchild, of the Kansas Agricultural College.

W. M. Hays, of Minnesota. I rise to move to adjourn; and in doing so I know we all feel like paying our compliments to our retiring president. I move to adjourn.

The motion was agreed to, and the convention adjourned *sine die.*

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[a] The term digestion, as above used, includes all the processes by which the nutrients are made available for use in the body.

MINUTES OF THE SECTIONS.

SECTION ON COLLEGE WORK.

In the absence of J. H. Raymond, of West Virginia, chairman of the Section on College Work, M. H. Buckham, of Vermont, was chosen to preside. Two sessions of this section were held, one devoted to a paper and discussions on the relation of agricultural colleges to the proposed national university, the other to a similar consideration of the value of short courses. Both sessions were well attended, and the papers and discussions held the closest attention of those present.

The paper on "The relation of agricultural colleges to the proposed national university" was presented by W. O. Thompson, of Ohio, who opposed any official relation between this Association and any private corporation like the Washington Memorial Institution, stating that, in his judgment, "the relation of the agricultural colleges to a national university should be that of sympathetic cooperation and enthusiastic support as against all other measures, whether proposed as substitutes or stepping stones." This paper provoked a spirited discussion, in which it appeared that there was a general sentiment in favor of some means for securing some agency under Government control for making the laboratories, museums, libraries, and other educational facilities in Washington available to advanced students.

W. M. Liggett, of Minnesota, read a paper on "The value of short courses," in which he described briefly the courses in the college of agriculture and the school of agriculture in Minnesota, and then turned his attention to the farmers' course of eight weeks for persons of mature age, given last winter for the first time, and to the short dairy course of four weeks, both of which he considered valuable adjuncts to the longer courses. The discussion of this paper was led by Hon. J. H. Brigham, Assistant Secretary of Agriculture, who spoke of short courses as a means not only of giving valuable instruction to farmers, but also of bringing about more cordial relations between the agricultural colleges and the farmers. To quote his words, "The best way to secure the support of farmers is to let them come to the college, even for a short time, and see what you are trying to do." Short courses differing from those in Minnesota were described by others who took part in the discussion. W. A. Henry, of Wisconsin, told how lack of agricultural students in the University of Wisconsin had led to the establishment of the dairy course and the farmers' course, both of which he described in detail. C. D. Smith, of Michigan, explained methods of college work in Michigan, stating that the four-year course was full of students and that the short courses were supplementary thereto. He also outlined the Michigan correspondence course. C. F. Curtiss, of Iowa, spoke of methods at Ames, where also the four-year course is full and short courses are supplementary. T. F. Marston, president of the Michigan board of agriculture and a student in the first short course in Wisconsin, advocated carrying education to farmers at home.

SECTION ON AGRICULTURE AND CHEMISTRY.

The sessions of this section were held in Carroll Institute Hall on the afternoons of November 12, 13, and 14, 1901, C. D. Woods, of Maine, chairman of the section, presiding.

Study of Grass and Forage Plant Problems.

The section first took up the consideration of the extent to which the United States Department of Agriculture and the experiment stations may profitably cooperate in the study of grass and forage plant problems, and what lines of work are likely to yield the most important results.

B. T. Galloway, of the United States Department of Agriculture. The Department of Agriculture has long recognized the importance and necessity of investigations looking toward the improvement of conditions governing the production of grasses and forage plants. Several years ago this work took active shape when Prof. F. Lamson-Scribner assumed charge of it, and its importance and value have steadily increased up to the present time. It was early recognized that to give practical value and weight to the work under way the close cooperation of the experiment stations would be essential, and for this reason their aid was sought almost at the beginning of the investigations. As is the case in all such matters, considerable time was spent in developing plans which would be fair and equitable to all concerned, and although these matters have received very careful thought and study, especially during the past two years, there are still a number of questions yet to be settled. It is not our purpose, nor is it the place, for any extended discussion of the broad questions involved in cooperative work as a whole. Suffice it to say that its value is fully recognized by us, and we do not believe that any instance need ever arise where cooperation can not be arranged with satisfaction to all concerned. There are few grass and forage plant problems at the present time which are local, and for this reason an excellent field is offered in building up a broad and liberal policy which will strengthen both the stations and the Department. I am of the opinion, therefore, that the future success of this work will, in a measure, depend upon the careful consideration of plans which will bring together certain stations into groups, as it were, utilizing one station in such a group as a central agency to further the work. I may make this matter more plain, perhaps, by calling attention to an important line of work in the Southwest, viz, that of range improvement. Many of you are no doubt familiar with the vast interests involved in this question and the urgent need for thorough investigation. Millions of dollars are at stake, and an opportunity for thousands to engage in a profitable industry is the issue. The Agrostologist of the Department has already inaugurated experiments, with a view of settling some of the questions involved in this problem, with the Arizona Experiment Station; but it is believed that other stations which have to deal with similar questions could be brought into the plan in such a way that there would be a united effort extending over a wide field and covering all phases of the work. There is no reason why one station should not be made the central agency for carrying out some such plan, with the Department to render assistance in the matter of furnishing men or equipment, as the case should require. Some such plan as this has recently been put into action in connection with a number of the Northwestern States, for the purpose of carrying on investigations and experiments looking toward the improvement of various groups by breeding and selection. The Minnesota Station has been made the central agency in connection with this work, and very satisfactory arrangements have been made through the agriculturists of this station with other stations in adjacent States, whereby a thorough working plan has been evolved. The advantage of such an arrangement is shown from the fact that there is a united effort along certain directions, made in such a way that decisive results can be obtained in the shortest time with the least expenditure of funds. Other examples might be given, but these are sufficient to merely call attention to the main points at issue and to suggest the general lines along which such work might be undertaken.

So far we have dealt with matters in somewhat a general way, and as time is limited and our session must necessarily be brief, I might, for the sake of bringing out a full discussion, summarize as follows some of the ways in which the Department of Agriculture and the experiment stations may, in our judgment, profitably cooperate in this work, and the lines which it seems to us are likely to lead to the best results.

(1) The introduction and dissemination of new and promising crops from foreign countries. It will become obvious on a little consideration that the introduction and dissemination of new and promising crops will afford an excellent field for future work in many parts of the country, and that the Department, acting in cooperation with the stations, is well equipped to carry on these investigations. In considering this matter, however, special attention should be called to the fact that in the future our best results, in all probability, will come through a concentration of effort on certain specific crops. Owing to various circumstances, it has probably been the case in the past that our efforts have been of too general a nature, and for this reason the very best results could not be secured. As to the relations of the Department to the stations in this kind of work, it is hardly necessary at this place to enter upon any detailed discussion as to what should be done. I believe that a thorough working system can be devised, a system whereby the Department will be able to materially aid the stations, and the stations would not be overburdened with receiving crops for which they have neither the time nor the place to experiment.

(2) The growing and disseminating of such crops as may have been introduced from foreign countries after they have, to a certain extent, become established. It seems to me that we have here a profitable field for work with the experiment stations, a field that will enable them—through certain aid that may be rendered by the Department—to develop crops which have already, to a certain extent, been established within the States. This work has already been entered into by a number of stations, and so far has proved very satisfactory.

(3) The growing and disseminating of native crops known to have local value, and believed to be worthy of trial in other sections. Here is an important field, and one worthy of careful consideration on the part of both the Department and the stations.

(4) The breeding of crops with special reference to securing new forms adapted to certain conditions. The problems in connection with this proposition are many, and cover some of the most important questions with which we are at present concerned. Already the question of plant breeding is beginning to attract much attention, and it would seem desirable and necessary to take some steps at an early day toward bringing together the experiment stations and the Department upon this important work.

(5) Increasing production by improvement in cultural methods, and methods of handling the crops. Under this class there are a vast number of questions to be considered, such as use of forage crops in soil renovation and maintenance of fertility; the substitution of forage crops for others now grown, with a view of meeting exigencies which may arise, as was the case last year from severe climatic conditions, such as drought, etc.; experiments with various crops to determine their adaptability to different soils and climatic conditions; and experiments to determine the range of various crops, etc.

Under this head we have an exceedingly broad field. It includes all those matters pertaining to the use of forage crops, soil preparation, maintenance of fertility, rotation of crops, and culture generally. I might go on and enumerate at considerable length the various lines of work which may be taken up. For example, we all know that many important lessons have been developed and brought out by this year's experience in certain parts of the West, through the effect of drought. We have seen the advantages there of certain changes in our system of cropping. The advantages to be thus gained are really important features of experiment-station work, and I see no reason why these classes of investigations should not be taken up by the stations in connection with the Department.

As to matters of detail covering the question as to the relation that the Department itself should have with this work, and the relations the stations should have to the Department, those are questions that we had probably better not take up at this time. I would only remark that the time has now arrived, it appears, for very much closer relations between the experiment stations and the Department. I believe that the Department, and I may say most of the stations, recognize this. The question is simply one of getting together, and I believe that if the matter be handled in a proper way we shall get together. Of course, in view of the varied conditions in the different States, together with the policy of the States and the policy of the Department, changing somewhat from time to time, it will require several years to shape matters so that we can have a general policy that can be applied in all directions. But there are certain fundamental facts which ought always to be considered, it seems to me, in this connection. In connection with our work we find it is the practice for our people to go out into the fields and talk with the experiment-station workers; and in the enthusiasm and the desire to see things moving attention may be turned to certain lines of work before the proper officers are fully cognizant of all the conditions. Now, in order to carry on this work properly, and as a matter of courtesy to the stations, it seems to me that before anything definite or official in this line is undertaken it ought to be the plan and the policy to have the first understanding come through the director of the station. He is in many cases in a peculiar position. It seems to me the work should be largely under the direction of the men who are directly interested in these subjects. If there is a definite understanding as to what line of action the Department is to take, and what line of action the experiment stations are to adopt, the matter will be perfectly plain and clear to all.

F. Lamson-Scribner, of the U. S. Department of Agriculture, explained the work of collection and distribution of seeds, grasses, and forage plants by the Department of Agriculture through the office of the Agrostologist, and cooperation in grass and forage plant investigation with a number of the experiment stations.

B. T. Galloway, of the U. S. Department of Agriculture (in reply to a question by W. A. Henry). It is our desire to have all the preliminaries arranged first by the director of the station. In order to avoid difficulty, it seems proper that the first understanding should be had through the director. Of course, in all cooperative work, it is sometimes difficult to restrain our people in the field. They may without thinking converse with some one very familiar with, or engaged in, some special line of work; and in this way statements may be made which in no measure commit the Department; and it ought not to be so understood. These statements should of course be considered as entirely unofficial. As to official statements, it seems to me they should, in all cases, be made between the directors of the stations and the official of the Department.

W. A. Henry, of Wisconsin, stated that he had known cases where friction and irritation had arisen because information had not been sought through the director of the station.

I. P. Roberts, of New York, asked whether it is the intention of the Department at Washington in extreme cases to send out someone to do the work at the stations.

B. T. Galloway. That matter has been very carefully considered. We are now endeavoring to place men at the stations wherever they are needed. Of course in dealing with this phase of the proposition there are still difficulties to be met, because the man sent out from Washington to the station must, in the first place, go there as the representative of the Department, but when he gets to the station he must, in a certain measure, conform his work to the policy of the station. The problems thus arising will, I think, be eventually solved by reason of the fact that we have recently inaugurated a system under which young men are taken into the Department under the general name of scientific aids; and these young men are proving their ability in carrying on this class of work. After a time we shall be able to send such men out to work at the stations upon whatever class of work the Department and the stations may agree.

H. P. Armsby, of Pennsylvania. I have been very much interested in this discussion, particularly Professor Galloway's paper, because, to me the work of the stations as a whole along this general line—not merely grasses and forage plants, but crops in general—has seemed the least satisfactory of the station work. This work has seemed to me in a good many cases rather aimless and groping. It seems to me that the suggestions made in Professor Galloway's paper were in the direction of broadening and deepening this work, giving it a more definite aim and a wider scope. That to me was really the most interesting part of his paper. The details do not happen to touch me personally, because our station is not cooperating with the Department in any of this work, though I wish we might be able to do so.

The following paper, by T. L. Lyon, of Nebraska, was presented, the author being absent:

Cooperative Experiments with Grasses and Forage Plants.

The production of forage is a matter of importance in all sections of the country, but in certain States, particularly in the South and West, the demand for an improved practice is such that the stations are directing toward it their best efforts. In this most of them have been aided by the United States Department of Agriculture, with its unrivaled facilities for such work. Cooperation has been quite general, but it has not been very systematic.

Each station has its peculiar problems to solve, and its workers are most familiar with the conditions under which they must be met. The initiative, therefore, would naturally be taken by the stations, and the general plans for experimentation be submitted by them. Methods and details would be a matter for joint consideration.

To my mind, the most suitable lines of work to be undertaken as cooperative experimentation are (1) testing new forage plants, (2) testing native species when grown under cultivation, (3) improving forage crops by breeding, and (4) management of meadows and pastures.

Something of the possibilities for usefulness of forage-plant introduction can be judged from the successes that have already attended the recent importations made by the Department of Agriculture. Awnless brome grass and Turkestan alfalfa are undoubtedly destined to be of untold value in the West and Northwest. The former has already become widely adopted, and the latter would be if the seed could be obtained in sufficient quantities.

Almost every region of the country has been furnished with some forage plant possessing qualities that make it useful to that region, and that, in some respects at least, gives it advantages over others already grown. The Russian field pea and Egyptian clovers in the South, the economic cacti from Argentina in the Southwest, March rape in California, and sand lucern in the North Central States, are some examples of the usefulness of these importations.

The yields and other measures of economic value of these introduced plants as compared with varieties already grown are not by any means to be considered as the final estimates of their possibilities. They must also be regarded as foundation stock for breeding, especially valuable because of essentially different and perhaps strongly fixed characters which they possess. Should a new plant yield larger quantities of forage than varieties already grown we have saved perhaps many years that would have been required to bring our own varieties to this point, but should the new variety not be equal to our own in productiveness it may yet possess certain characters, such as hardiness, drought resistance, early maturity, etc., that would make it most valuable for crossing with our own varieties.

For these reasons I consider the testing of new plants one of the most important lines of experimentation upon the stations, and owing to the unequaled facilities which the United States Department of Agriculture possesses for collecting foreign plants its cooperation should be sought. The advantages of having some central agency like the United States Department of Agriculture to take charge of plant introduction is too well understood and approved to need discussion here. On the other hand, it is equally desirable—in order that the plants and seeds when imported should receive the most careful tests of their adaptability—that their distribution in any State should be regulated by the station in that State, and that everything thought worthy of trial in the State should be grown on the station farm. The plan lately adopted by which seeds are sent out from Washington only to parties recommended by the stations seems to me an excellent one, but it may under some circumstances place the station officers in an embarrassing position. Plant and seed introduction for experimental purposes should not be mistaken for the free and indiscriminate distribution of seeds that Congsess indulges in. In order that the tests should be of value it is desirable that the distribution of seeds should be limited to parties upon whom the station can rely for a carefully conducted test and accurate report. The station workers should therefore be allowed perfect freedom in selecting the volunteer experimenters. This may be a delicate matter in case the importation of the seed in question has been widely advertised, thus causing the station to be flooded with requests for seeds. The refusal of these requests is apt to produce hard feeling and decrease the popularity of the station in its own State. I consider it detrimental to the proper prosecution of this work for the United States Department of Agriculture to advertise its importations through the daily and agricultural papers. If the stations are responsible for the judicious distribution of imported seeds they should be the only agencies through which these importations become known to the public. The only alternative is to send seed to all applicants, which must weaken the experiment unless a very large amount of seed is available. The distribution of seed in very small quantities to individuals invites failure. It is desirable that sufficient seed be furnished to make it an object to the volunteer experimenter to use every means possible to make the crop he is experimenting with a success. Failure is easy, and may result in the loss of a good thing. We endeavor to furnish our cooperative experimenters with sufficient seed to sow at least 1 acre of the crop to be tested. In case the plant is a success it is then soon on a commercial basis.

An inventory of all importations kept strictly up to date by means of supplements would be of great help to station workers. As this would be intended for distribution only among the stations it could be mimeographed in sufficient numbers. I would suggest something similar to Circular No. 9, Division of Agrostrology, which contained condensed notes on seeds of the native grasses available for distribution.

The testing of native grasses under cultivation is in some portions of the country one of the most important phases of forage investigation. In regions of limited rainfall, high summer and low winter temperatures, to which conditions the ordinary cultivated perennials are not well adapted, it becomes of importance to ascertain the effect of cultivation upon grasses that have in the wild state shown themselves of value. These grasses act differently under cultivation from what they do in their native state. Under cultivation they grow more luxuriantly, seed more prolifically, and some of our experiments indicate that they are less hardy against cold, and perhaps less drought resistant. Certain of these prairie grasses, however, give promise of great usefulness under cultivation. At the stations where it is desirable to conduct this work the cooperation of the United States Department of Agriculture may well be sought. The same conditions that make it desirable that this Department of the Government should import foreign seeds makes it equally urgent that it should collect seeds of the native grasses and other forage plants.

The same general methods of procedure may govern this line of cooperation as hold for experiments in plant introduction. Some of the details will have to be modified. It will be necessary to depend more upon tests on the station farm and less upon volunteer experimenters. One reason for this is the difficulty in getting sufficient seed to distribute to parties throughout the State, and another is the disinclination of voluntary experimenters to devote the very considerable amount of work and attention which the preliminary tests demand. Our experience has indicated that it is better for the station to make preliminary tests with a large number of grasses, and after selecting the most promising, which will require several years, the seed of these may be sent to parties throughout the State.

Regarding the terms of cooperation in these two classes of experiments it seems to me that the plan in general use is a fair one to both parties—that is, that the United States Department of Agriculture should furnish the seed, and that the respective stations should furnish the land, labor, and supervision for tests carried on at the station and the supervision of tests made throughout the State. The latter should imply something more than merely furnishing names of parties to whom seed may be sent. It should mean a personal or at least an accurate knowledge of each experimenter and of the conditions under which he would be likely to carry out the test.

Reports of each test should be sent to one of the two institutions, upon receipt of which a duplicate should immediately be made and sent to the cooperating institution. The results would then be available for the use of either institution when desired.

In the third class of experiments, namely, improving forage crops by breeding, there is abundant opportunity for cooperation between the United States Department of Agriculture and the stations. The former, through its corps of trained agrostologists, is capable of adding greatly to the efforts of the stations in their attempts at forage-crop improvement. The number of stations conducting cooperative experiments of this kind must of necessity be limited, for if the national department is to assist it must be by detailing a trained agrostologist at each station with which it is cooperating. That, as far as I can see, is the most effective way in which the United States Department of Agriculture can take an active part in experiments of this kind. The possibilities for usefulness in this work are enormous, especially for some of the western stations. When definite results have been obtained from seed importation and native grass tests, experimentation in forage-plant breeding will naturally follow. The first two forms of experimentation will provide foundation stock well adapted to the several regions of the country and which can be further built up by judicious breeding.

Experiments in the management of meadows and pastures would also admit of cooperation. These experiments might be carried on at the station or perhaps more profitably at some other point or points in the State. They would admit of considerable latitude as to the degree of participation by either paty, but whatever the arrangements might be otherwise, it seems to me desirable to have a representative of the national department continually on the ground. Without this the United States Department of Agriculture must feel that it is powerless to look after its own interests in the experiment and the station must be responsible to the Department for the whole work. Both in this and in the plant-breeding experiments it would seem fair that the two cooperating institutions should divide the expense of operation.

ARTIFICIAL PLANT FOOD REQUIREMENTS OF SOILS.

B. W. Kilgore, of North Carolina, read the following paper on this subject:

Experiments for the purpose of determining the best proportioned as well as the best paying fertilization for different crops were among the first inaugurated by the experiment stations in the fertilizer-using States. These investigations have been continued in some form in most of these States, and in a few of them have been put on such a well-considered and permanent basis as to have already yielded results of very great scientific interest and of immense money value, as represented in the more efficient and economic purchase of artificial plant food and in increased crop production. While this is true, I feel that I may say, without the least fear of wounding the feelings of any one, that a large amount of the early work, at least of the stations along this line, has been productive of very little good. This has been due, in a measure, to want of well-matured plans and to short duration of work. Failures are often necessary to point the way to success, and fertilizer experimentation under the most favorable conditions is difficult. All of our methods of work have been and are now in process of evolution and development, and as so much of the value, as well as the general application of results, depends on methods of conducting experiments, it would appear that the time of these meetings can be no better spent than in discussing results rather than the method of conducting work.

Now, just a word in regard to the importance of fertilizer tests, which I can, perhaps, best enforce by a reference to my own State. For use on spring and summer crops, the farmers of North Carolina paid this year for fertilizers about $6,000,000, which amount will be considerably augmented by purchases for fall and winter crops. I am willing to take the responsibility of saying, at the risk of having come upon me the criticism of not having measured up to the full responsibility of my duty to the farming interests of my State, that a considerable quantity of this large amount of fertilizer was not used economically, if it was purchased to best advantage. The great and immediate need for investigations of this kind will be further seen when I tell you that of the 691 brands of fertilizers registered for sale in my State in 1900, 83 were guaranteed to contain 8 per cent available phosphoric acid, 2 per cent each of ammonia and potash, and were, by their brand names, recommended as "specials" for the following crops:

For no special crop	51
For tobacco	14
For cotton	6
For cotton, tobacco, and all spring crops	4
For cotton and corn	3
For corn and peanuts	2
For wheat	1
For grain	1
For grain and grass	1
Total	83

While a strong advocate of uniformity, I do not believe that the plant food requirements of all of these plants were made uniform by being fed fertilizers of the same composition. If so, then the question of fertilizer tests is settled. It would appear that we could have no better illustration than the above to impress upon us the fact that the stations can do for the farmer no better service than by pointing out to him more systematic and efficient methods of purchasing and using fertilizers. How can this best be done? I bring before you without any thought, much less claim to originality, the plan the North Carolina Experiment Station and the Department of Agriculture is following in their efforts to throw light on this subject.

In the first place, we are examining our soils with the view of ascertaining the locations, extent, and relative importance of the different type areas, and are making a large number of analyses, in as thorough a way as we know how, of these several kinds of soil, having in mind that a thorough understanding of the soil is the basis of the best agricultural practice. On the important type areas we are conducting, or are preparing to conduct, fertilizer tests, along with culture, rotation, and new crop tests, and hope to continue them on definite plans for a sufficiently long period of time to enable us to throw additional light from year to year on the fertilizer requirements, culture methods, rotations, and suitability of crops now used and not now used to the different conditions and sections of the State. On two type soils, away from the main station, we have been conducting fertilizer tests for two years on plats laid out and fertilized according to the following scheme:

FERTILIZER TESTS ON COTTON.

Normal application 400 pounds to acre of mixture containing—	Per cent.
Phosphoric acid	7
Potash	2½
Nitrogen	2½

In scheme below—

P =28 pounds phosphoric acid=200 pounds acid phosphate.
K=10 pounds potash=80 pounds kainit.
N=10 pounds nitrogen=143 pounds cotton-seed meal.

No. of plat.	Applications.	Remarks.
1	N	
2	P	
3	K	
4	NP	
5	NK	
6	PK	
7	NPK	
8	0	
9	N½ PK	
10	N2 PK	
11	N3 PK	
12	NP ½K	
13	NP 2K	
14	NP 3K	
15	NP K½	
16	NP K2	
17	NP K3	
18	½ (NPK)	
19	1½ (NPK)	
20	2 (NPK)	
21	2½ (NPK)	
22	0	
23	NPK	Culture.
24	NPK	Rotation.
25	NPK	Do.
26	NPK	Do.
27	NPK	Nitrogen from nitrate and meal.
28	NPK	Two applications of nitrogen—both as meal.
29	NPK	Two applications of all materials.
30	Lime	
31	NPKL	

The plats are one-tenth acre in size, being 21 by 207½ feet, and have spaces between them of sufficient width for two rows of the crop under test, the rows on the two sides of the plat being fertilized like the plat, but the yield is not counted. Between two series of plats in different crops is a roadway, about 12 feet, for use in observation and for turning. In the sections where these tests are being conducted large areas of level and comparatively uniform land are to be obtained.

I consider it important in this kind of work to go to that section of a State where the particular type of soil on which it is proposed to experiment is found in large quantity and under the best average conditions. The results will then be obtained under the same conditions that they are to be applied by the farmer, and, if well done, the tests will serve as an object lesson for the section. It is hardly necessary to add that it is all important in plat work of all kinds that the land should be of uniform richness and evenness of character, so that a uniform series of plats can be laid out, for plat experiments, at best, are subject to many inaccuracies because of uncontrollable conditions. This makes it all the more necessary for all concerned to meet on common ground and discuss the difficulties and adjust their differences, if there be such, and no one will welcome more than I will criticism of any plan of work that I may follow, provided it will only enable me to do the work better.

B. W. Kilgore (after reading his paper) said: In addition to this brief paper, which was intended rather to open the question assigned for discussion and to give briefly the plan we are following, allow me to say that the Department of Agriculture is supplementing the work of the North Carolina station and is expending money in the examination and location of these types of soil of which I have spoken. It is also assisting the station in the conduct of experiments upon the type areas.

Mr. Kilgore exhibited four of the leading type soils in North Carolina, viz, (1) a strong clay soil, (2) a clay soil with loam on top, (3) a tobacco soil, and (4) a trucking soil.

R. J. Redding, of Georgia. Mr. Chairman, I have had an experience of some twelve years in fertilizer tests on the same soil, and my conclusion is that the test of a fertilizer is not worth much unless it is repeated for at least five years, and according to my experiment it is very desirable to continue the experiments ten years. This would seem to indicate that there is not much in fertilizer tests. They are often disappointing; they "gang aft a-gley." They do not turn out as we expect. There are a great many details in conducting the experiments which require careful attention.

H. J. Wheeler, of Rhode Island. In every State there are hundreds of different kinds of crops, and in the various States we must deal with many different kinds of soil. It is obvious, therefore, that we must devote ourselves at the outset to but a few of the most important crops and study each class of soil by itself. Without going into a discussion of each variety of soil and of crops, I shall endeavor to point out some of the difficulties to be met.

The first question is drainage. The losses which take place on account of drainage vary greatly according to the soil. I think they are greatest in the case of sandy soil, hence the losses upon sandy land do not represent those upon clay or loam or muck.

Furthermore the materials which we apply to the soil undergo changes, and they are not the same in sandy soil as in muck, clay, or ordinary loam.

The land losses by drainage, as already stated, are variable, though they can be somewhat accurately determined for each class of soil by an analysis of the drainage water. The changes within the soil are complex and obscure.

Let me give a simple illustration of how we may arrive at the needs of our soil. Let us suppose that for State A a particular rotation and a particular soil are the most important. In proceeding with a given rotation we should take first the soil which is most nearly representative of the entire State, or in other words, we take the most important soil and the most important rotation. Having laid down the definite rotation, we have one thing which is constant, for we know what plants are to be grown each year. If we start with a given soil to carry on our experiment we may find that for a few years we have present enough of a given manurial constituent. Experiments were begun in 1894 in Rhode Island for the purpose of studying the potash and soda question, and for four or five years the soil itself yielded enough potash to supply the needs of the plants even when two crops were grown annually.

Suppose we carry on our experiments in a similar way, omitting only potash from the manures and continue our rotation year after year until we find it no longer possible to obtain satisfactory crops. Then let us lay out upon this land four or five plats. Upon the first plat we continue to eliminate potash entirely, supplying the land with everything else that it may possibly need. On plat No. 2 we apply a quarter ration of potash in addition to the other manures, and then successively increase the amount of potash upon the remaining plats. Now, by watching the returns year after year, one is able to ascertain what is the minimum allotment of potash that will produce satisfactory crops. It seems to me, therefore, that by such means one will be able in a few years to determine (with a given rotation upon a given soil) how much potash over and above any which may be lost by leaching and in excess of that which is liberated annually from the soil it is necessary to apply in order to produce good crops.

I do not see why the same method of experimentation may not be applied upon other series of plats for phosphoric acid, nitrogen, magnesia, or lime, the land having first been prepared by exhaustive cropping so that the element under consideration has become deficient. Such results upon a given soil should be applicable to similar soils wherever the rainfall and climatic conditions are analogous.

The question of the needs of soils which have been long under cultivation is the most difficult one that the experimenter has to meet at the present time, but I think the method described is the most logical one in the absence of satisfactory direct chemical methods of ascertaining what the soil lacks. The fact that it may take many years to solve the problem even for a single soil and rotation should not deter station workers from engaging in this line of effort. If we are to attack only such problems as seem easy and to admit of quick solution, we shall fall short of our duty and may expect to see other nations surpass us in the line of agricultural investigation.

C. S. Plumb, of Indiana, referred to experiments in which stone walls 8 or 10 inches thick and going down to a considerable depth have been used to separate the different experimental plats and prevent the fertilizers from spreading from one plat to another.

W. H. Jordan, of New York. This matter of fertilizer tests has gone through all sorts of phases. I had something to do with compiling the results of Dr. Atwater's early experiments in a good many States. I have some knowledge of what others have been doing, as well as what I have tried to do myself. I am afraid I shall have to inject into this discussion a grain of pessimism. After watching these things for years, my conviction to-day is that it is not possible to group the soil of any State into a sufficiently small number of classes to reach any definite rules that can be useful. I think we must reach the conviction that this problem of fertilization is a problem for each farm simply—not only because of the character of the soil, but because of the business conditions that enter into the question. It will pay some farmers to do things which other farmers can not or will not do. Much depends on the way in which a farmer manages his farm and sells his products, etc. I believe the most we can do as experimenters is to show the farmer how to study his own conditions. I am talking now about field tests.

Another point is that frequently we do not know what the plants need. We have been in the habit of assuming that a plant takes up what it needs. But, in my judgment, that is very far from correct.

In the study of plant-food problems we have some things to determine which we can not determine in field work, but must arrive at by close and severe investigation. I am sure nobody disagrees with that position. But in the present stage of our work I think that these field tests will be useful to us mainly in showing us how to observe rather than in working out any rules or deducing any scientific conclusions.

C. E. Thorne, of Ohio. Mr. Chairman, in some respects I can agree with what Dr. Jordan has just said; but, after eight years of work on a soil selected originally for adaptation to this special purpose, and then prepared without regard to expense for the work by drainage and other methods, I am more confident than ever before that there lies before the field experimenter an opportunity far greater than most of us comprehend. But valuable results are not to be obtained by any desultory investigations. Such results can only be reached by (1) elaborate preparation, and (2) long-continued observation without interruption. The work of field experiments is not the work of one year, or two years, or ten years, or twenty years. It is the work of a generation, of a century, and it must be organized and planned upon a basis which may be continued indefinitely if it is to accomplish fully its mission.

Of course I claim that long before a century has passed, results of enormous value may be obtained; but I wish to emphasize the fact that this is not a work to be taken up and thrown down spasmodically, but is one to be continued indefinitely and persistently.

One important thing, already referred to in this discussion, is the necessity for a strict regard to the number of plants growing in each plat. We find it necessary to count not only the rows of plants but the number of plants in the rows with all our larger growing crops. Of course with smaller grains this is not practicable. Another point that we consider of vital importance is the repetition of standard or check plats. We find that we need such plats at frequent intervals.

W. H. Jordan. One thing which we ought to emphasize, perhaps, in this work more fully than we are doing is what we may call plant environment. As I have watched the practice of many farmers who have never bought a pound of fertilizer, I have been more and more impressed with their success in keeping up the crop-bearing quality of their soil to a high standard by proper culture and by careful attention to conditions. I believe that perhaps we have gone too far in striking chemical balances, and that the environment feature is relatively of greater importance than we have recognized it to be when we have concentrated our attention upon the commercial fertilizer problems.

J. S. Newman, of South Carolina. We find that if we continue experiments with cotton for a long series of years, the land, no matter what we apply to it, becomes decidedly deteriorated. In order to arrive at a definite conclusion we have been obliged to continue our experiments as long as five years, and we do not attempt to draw conclusions from experiments extending over a shorter period because we can not control the meteorological conditions. If we continue our experiments on cotton lands for a long period, no matter how much fertilizer we apply, the land deteriorates from year to year after a given time, on account of the destruction of the humus. So that, as Professor Jordan has said, we must take the environment into consideration all the time. These investigations can not be pursued in the same way in any two States unless there is an exact similarity in soil, climatic conditions, etc.

I agree with Dr. Jordan in another respect. I think that in general we can not lay down any principle which will be applicable to any considerable area. As Dr. Jordan has said, we have got to wake the farmer up to a study of his own business. We can aid him in supplying certain general principles; but as to details, he must apply those in accordance with the requirements of his soil and environment.

C. E. Thorne, of Ohio. By continuous experiments I do not mean continuous cropping. We have been carrying on continuous croppings for the last thirteen or fourteen years, and we have reached the conclusion that results based upon continuous cropping would be absolutely misleading. Our continuous experimentation is with crops which follow each other in rotation, and out of this system of rotation we have already worked one very interesting conclusion—that it is not so much the soil or the crop of a given season that controls the choice of the fertilizer needed as it is the crop which preceded. We are working on soils differing considerably in character. We are getting results of very close uniformity as to the kind and quantity of fertilizer that should be applied to those different soils. We are believing more and more in the possibility of bringing out results which will be applicable to very large areas, but these results must be considered in careful connection with the geological history of the soil on which we are working.

H. J. Wheeler, of Rhode Island, thought that planting an extra amount of seed and thinning to secure uniformity was preferable to transplanting, but he was of the opinion that better comparative results are obtained by planting the same amount of seed on each plat, letting the stand be what it may. "If you are going to compare conditions you must take the natural conditions and not force artificial conditions upon the plant."

E. H. Jenkins, of Connecticut. The first thing to do in making these experiments is to secure soil absolutely uniform. That goes without saying. But this uniformity of soil can not be ascertained except by experiments continuing over a term of years. Connecticut is a small State, but we have there every variety and type of soil—all within a stone's throw of each other. You can not pick out two plats in the whole State that are uniform. I know of farms where a part of the soil is benefited by phosphates, while on other parts phosphates are of no benefit at all.

Then, with regard to rotation of crops, there are many crops that can not be raised in rotation. Tobacco, our leading cash crop in Connecticut, has been raised for forty years on the same land, and it grows better now than it did at the beginning.

After watching and having some share in these field experiments for nearly twenty-five years, I have become, like my friend from New York (Dr. Jordan), something of a pessimist. I feel that we can do a good work in recommending the farmer to buy fertilizers economically—in persuading him that the purchase of artificial fertilizers is the very last thing to be done. He has no business to touch them until he has his land properly drained and otherwise prepared for cultivation. As a very last resort, in order to put the "razor edge" on his farm, he may resort to fertilizers, but he should buy them economically; he should buy them cheaply. The giving of this sort of instruction to the farmer is about all we can do as the result of these field experiments with fertilizers.

Irrigation in the Humid Regions.

Elwood Mead, of the United States Department of Agriculture. Mr. Chairman, the application of irrigation in the humid sections of the United States is a new question. It presents many unsolved problems. We are dealing with a question the boundaries of which are not clearly defined. In regard to this matter we stand about where the irrigators in the arid regions stood thirty years ago. They knew that irrigation, as far as they had carried it, was a success, but they did not know how long it would continue to be so. It was a success then because of the local demands, because of the necessities of the country, because those who raised crops in that region were able to command high prices for them. But they were not assured that the system would continue a success when railway transportation and cheap freight rates had brought them into more direct competition with the farmers of Illinois and Iowa.

But that system has maintained itself; and there is no question now as to the success of irrigation where it is a necessity. Every year has caused a growing appreciation of its importance in the development of large areas in the arid West. But the fact that irrigation has been profitably applied in the arid regions does not alone warrant its extension to other parts of the country where it is not a necessity, but simply an adjunct to agriculture. In the arid regions of the West the problem is a different one in a number of respects. Water has to be provided in large quantities and for a much longer period of time. Hence the expense of irrigation in the arid regions is greater than it will be in the humid regions where it only supplements the rainfall and where the necessity for its application is for a brief period only.

In the arid regions of the West the fact that rain does not fall relieves the agriculturist from any fear of excessive moisture. In the East a serious problem arises from the danger that after the land has received artificial irrigation, a rain may come and an excess of water do more damage than drought.

This seems to be the general aspect of the question. It is being considered, because as agriculture becomes a more highly developed and more scientific industry, we seek to reduce the destructive and wasteful practices of the past and consider those things produced under intensive or more scientific cultivation. It is a great achievement to be able to apply moisture at the proper time and in the volume needed. The experiments being made in this direction indicate a large field of usefulness for this kind of inquiry.

In the humid portion of the United States the largest employment of artificial irrigation seems to have been along the eastern seaboard—on the Gulf and the Atlantic coast. Perhaps the more fertile soils of the interior have delayed its application there. But certain it is, so far as practical experience is concerned, our most instructive lessons on this subject have been along the eastern coast. Its largest use is in the cultivation of rice. In Louisiana and Texas more miles of irrigating canals have been built and more money expended in pumping plants within the last two years than in any of the arid States; and I surmise it is true that more money has been expended in pumping processes than in any other two or three of the arid States. The development of rice irrigation has passed beyond the stage of experiment. It is to be an enduring and very important success. Throughout the rice-raising region of Louisiana, which is 200 miles long and 50 miles wide at the widest place, land has risen in value from $2 to $10 an acre, and from a very indifferent pasture it has become worth from $25 to $100 an acre for rice cultivation. In some instances the entire cost of the land has been paid by a single crop of rice. So large a demand has been created for pumping machinery that the manufacturers are sending experts there with the idea of designing water-raising devices especially suited for that industry. They realize that this is not a transient but a permanent demand; that very much of the success of the industry and very much of the rapidity with which it is extended depends on the cost of the pumping plants which supply the water. So they are engaged in the work of designing apparatus especially fitted to this particular pursuit. The success obtained by the introduction of efficient methods of irrigation in Louisiana and Texas has led to renewed interest in the subject along the Atlantic seaboard. The flow of the natural streams has been supplemented by storing water in the higher lands, and in this way one difficulty connected with the irrigation of rice along many of the Southern rivers—the entrance of salt water during the low water season—has been avoided. The ordinary discharge of the river is used for a large part of the year, but when the stream is low the current is not strong enough to keep the sea water back and the stored water is utilized. In this way one of the oldest forms of irrigation in this country, right along the Carolina quays, is having renewed vigor infused into it by more systematic methods. The use of irrigation in intensive cultivation along the Southern coast line and in the regions around the large cities is proving a success.

I am not going to dwell on that, because Professor Voorhees is prepared to speak more intelligently regarding that subject than I can. But, in a visit to Massachusetts last spring, I was very greatly surprised to observe the extent to which artificial watering is being employed wherever the amount of money invested in the cultivation of land and the value of the crop make the insurance which irrigation gives against drought an important consideration.

During the last two years the scientific and efficient study of the utility of irrigation in the interior of this country—especially in the Mississippi Valley—has been undertaken; and the last year has been a very favorable one for determining its possibilities.

There is another influence which, I believe, has very greatly tended to extend the application of irrigation to Eastern farms, and that is the remarkable advance made in the efficiency and reduction in the cost of pumping machinery. If men had to expend thousands of dollars to divert the Eastern rivers, it is probable that the large outlay required would be prohibitive; but if it is possible to have a gasoline or wind engine that will provide the water supply for 5, 10, or 20 acres of ground at a very little expense and procure for this service a motive power for the operation of which skilled labor is not required and only nominal attention to see that its operation is successful, then it is possible at a small outlay to provide for the irrigation of farms and to water gardens just as lawns are now watered.

In this way I believe there is destined to be a very considerable application of irrigation in agriculture, which in the aggregate will amount to an important contribution to the productive wealth of the country.

Besides, there are in the East many opportunities for impounding water in small bodies and utilizing it in the cultivation of crops which yield large monetary returns and hence justify this outlay. So far as we know, therefore, it is reasonable to believe that irrigation will develop here the same as it has in European countries; that wherever it is possible to obtain water at reasonable cost, there the agricultural or horticultural productions and the cultivated area can be almost indefinitely extended. Especially in the southern part of the United States, these improved methods of irrigation are destined to have, in the manner I have indicated, a large field of usefulness.

E. B. Voorhees, of New Jersey. Mr. Chairman and gentlemen, the matter that I have to present consists very largely of impressions gathered from the results of experiments which have been conducted in a particular part of the East, rather than actual facts concerning the possibilities of profitable irrigation in the various portions of the humid region.

We have conducted experiments for five years in various parts of our State (New Jersey), and with various crops; chiefly, however, with such crops as are liable to be injured by short periods of dry weather rather than those crops that would be regarded as general crops. In the first place, however, we made a very careful tabulation of the rainfall data for sixty years, taken in Philadelphia and New York, and from those data we gathered certain information as to the methods of experimentation. It was shown, for example, by the data gathered in Philadelphia that during the period of sixty years there were three years out of five when the weather conditions were such as to injure all crops—when everything would be injured more or less; but in all those years the conditions were such as to injure some one crop every year, and usually that one crop was the money crop in some particular line of farming. Naturally, these data led us to believe this would be a very wise line of experimentation. Hence, in pursuing our work, the experiments were confined to those crops which could be grown on small areas and which were of high market value. They included blackberries, raspberries, gooseberries, strawberries, and a number of market-garden crops.

The first thing determined was that water was really needed in all the five years during which the experiments have been conducted. It has been found in most of the crops that there has been a very considerable gain in yield from the application of water. Nevertheless, it has been shown in a very striking manner that these crops differ materially in their needs for water. For instance, it was shown that where blackberries unirrigated died, asparagus alongside was growing luxuriantly. More than that, it was shown that where water was supplied to blackberries in what was regarded as sufficient quantities, the difference between the unirrigated tracts and the irrigated tracts was the difference between practically no crop and a large crop, whereas with asparagus, where the land was irrigated the crops were really poorer than where the land was not irrigated—showing a very marked difference in the effect of water upon crops growing side by side on the same land and receiving practically the same amount of water. This problem is not simply one as to the application of water. The subject of irrigation must be studied in reference to the peculiarities of crops with regard to their need of water. That is something that we have not yet gone into. While in a general way it might be supposed on the face of the matter that the crops which are regarded as of highest value would be very largely benefited by water, it is not always true. Certain crops respond to irrigation and certain others do not. This involves questions which we shall have to take up in our further experiments.

Naturally, the second question that suggests itself after the facts have been obtained as to the need for water relates to the method of applying the water; and since the crops of high market value, and which are grown on relatively small areas, seem to be benefited in a greater degree than others by the application of water, the first line of work was to establish small irrigation plants and study the practicability of using these plants for the improvement of the crop; for instance, whether a plant costing $500 and capable of irrigating 5 acres under the average conditions that we have in the humid regions would pay, provided there were free access to water. In practically every instance where those plants have been established the men who have established them have demonstrated that it is a very profitable operation. In fact, I have yet to find one owner of such a plant who does not say that the cost of the plant in wear and tear upon his nervous system was not paid for in the first crop by the increased production. In nearly every instance those with whom I have talked who have put in a plant of this kind have said that it has paid for itself the first year with reference to crops which grow quickly and are harvested within a short time after planting.

We have not extended the experiments to the larger areas nor to the larger crops. That work is going on now, but we have not the data which would enable us to determine whether the results will be as satisfactory as with smaller plants.

We have made a number of surveys and calculations as to the cost of irrigating larger areas by pumping stations, and we are of the opinion (although this view may be modified later) that the method will not be practiced to any considerable extent until the public—that is, the financial public—is convinced of the value of such plants from the results on small areas. We have not yet been able to figure out that we could get a central pumping station that would take care of a large area for less than about $200 per acre (I am speaking of the original cost), which means a very large expenditure to a small farmer or an individual farmer. But, as Professor Mead has said, that is a question which will come up later—which will naturally follow the demonstration of the value of the results obtained from small plants.

There is another question with which we have to deal in our State, and it is one which, I presume, would arise in perhaps all the States east of the Mississippi River; that is, the question of water rights. We have met that question already in our State in the matter of water supply for even small plants. It seems that the mill owners have the first right on the streams of our State, provided some water company has not come in and taken it away from them. In one or two instances where persons farming in only a small way have taken the water from streams for the irrigation of grass—that is, on a larger area than would be practicable for a small plant—they have run up against this question of water right; and they have been served with notices that if they continued to use the water for irrigation, even in a small way, they would be stopped by process of law. This is a question which of course will have to be settled in conjunction with the question of irrigating large areas.

Methods of irrigation will of course prove to be a very important question. As has been pointed out by Professor Mead, the question in the humid region is a very different one from what it is in the West, because we in the East during a time of drought are constantly expecting that it is going to rain. The possibility at any given time during a drought that it may rain the next day will nine times out of ten prevent the application of water when it ought to be applied. I am satisfied that we have not as yet reached as good results as are possible because of this tendency, inbred in us, to expect rain "to-morrow," and so to postpone the time when we shall apply water.

This is a question that we have got to meet. We have got to study the problem from the standpoint of the irrigator in the West, who applies the water when he knows it ought to be applied, paying no regard, as we do, to the possibility of a shower which may give 3 or 4 inches of rain, and if water has been before applied artificially, may make the soil too wet. This is a problem which I am satisfied practical men will meet and settle.

Another question that comes up—and it will naturally come up with a limited supply of water—is how much water to apply, and this question we are just beginning to deal with now. Our first work was to calculate the normal rainfall of our section, and then apply whatever quantity of water might seem necessary in view of the average rainfall. We have calculated that the average rainfall affords a sufficient supply of water, if well distributed; but nine times out of ten, when we supply as we suppose enough water to meet the demands of the situation, we fail to do so, because we do not bear in mind that the conditions are widely different in a time when the sun shines all the time from the conditions prevailing when there are occasional showers. We have come to a point in our work where we believe that we must apply the water earlier than we have done in the past—a considerable time before the plant shows any indication of a lack of water—and then we must apply a good deal more than seems to be necessary to meet the average demand of a plant through an average season; that is to say, instead of half an inch to-day and half an inch three days or a week later, it is often best that we should apply an inch and a half at one time, thoroughly saturating the soil. We have found it very much better, on the whole, to apply a considerable quantity of water at once than to apply smaller quantities at frequent intervals.

Yet this does not hold true for all crops. With certain crops in a certain kind of soil smaller and more frequent applications of water seem to work much better than larger applications at longer intervals.

Another problem is how to apply the water, and in connection with this we have encountered a great many difficulties because of the differences in the crops and in their needs for water. For instance, we have found that irrigation by the furrow method is much superior to sprinkling for sweet potatoes, while for onions the sprinkling method is superior.

So, because of the wide diversity of crops, there are peculiar conditions which arise to modify any positive statements of a general character which might be made as to the possibility or the profitableness of irrigation. Yet I am satisfied that in most of our Eastern States, where, as we know, water is constantly running to waste, and where at small expense some of it could be diverted for irrigation purposes, the adoption of an irrigation system would be a profitable thing. We have enough dry weather to make it desirable that an artificial supply of water should be at hand, and the question presented is whether it would be advisable to use irrigation plants for carrying the water over larger areas for the good of our general crops.

I have thus outlined in a very cursory way the work we have begun and the impressions that have been gathered. This, I think, is all that can be done at the present stage of the work. We are satisfied from what has been done that a system of irrigation is feasible in the humid region. But while we are satisfied of its feasibility on a small scale and for valuable market-garden crops and for fruits, we are not satisfied that it is a feasible thing on a large scale.

F. H. NEWELL, of the United States Geological Survey. Mr. Chairman, by your kind courtesy I have been invited to say a few words on this subject of irrigation.

My interest in the subject of irrigation may be said to date from a very early period of my life. As a boy, brought up on a Massachusetts farm 12 miles out of Boston, I had an opportunity to see irrigation practiced, although we did not call it by that name.

From my earliest recollection water was turned from our ditches into the orchards, gardens, etc. Of course, boy like, I would spend most of my time fussing with the irrigating ditches, putting water on the fields; so that I became an irrigator before I was aware of the fact. Only in mature life did I recognize the fact that we were then practicing irrigation. My grandfather, who had visited France and had seen many of the excellent efforts there in the way of irrigation, brought over irrigating machines about 1840 and introduced in his community a system of irrigation which was continued for fifty or sixty years on that little farm near Boston. The success obtained there has been quite notable, although it has hardly been copied to any considerable extent. The apple trees, pear trees, and other varieties of fruit trees planted at that time are many of them still living. The trees along the irrigating ditches have attained a very wonderful size and have always borne large quantities of fruit.

But this subject has not been one of scientific observation and study there. The old farm has gone to decay, like many old Massachusetts farms. But all through New England and in other parts of the United States I have found many farms of that kind on which irrigation has been practiced for fruit and vegetables.

Let me now refer briefly to the work done in connection with the agricultural branch of the census. In the Eleventh Census, taken in 1890, we made a review of the conditions in the arid region alone. In the Twelfth Census, however, we shall have a complete statement in regard to irrigation as practiced in all parts of the United States.

In the agricultural enumeration taken for the Twelfth Census, that for the crop year of 1899, the enumerators were instructed to note on their schedules the facts as to whether irrigation was practiced. This was intended primarily for the arid and subhumid regions of the country, but as the same schedule was used for all parts of the United States it resulted that instructions were sent to every enumerator East as well as West. As a result it has been found that irrigation is reported from nearly every State. The totals have not yet been made public, but it is somewhat surprising to see the great extent to which the artificial application of water to the soil has been practiced. For example, in Connecticut 56 farms, with a total area under ditch of 471 acres, were reported as irrigated. The cost of the ditches, pipes, pumps, reservoirs, and other appliances for obtaining and conveying water to these farms was estimated at $16,113, an average of $34.21 per acre irrigated.

The results obtained by the census demonstrate the fact that for intensive farming irrigation is being practiced in all parts of the country irrespective of the amount of yearly rainfall. There are nearly everywhere to be found light, open, warm soils, capable of producing large and early crops if supplied with the proper amount of moisture. These soils, however, dry out rapidly, and unless the season is unusually wet there are periods when plant growth is retarded and the yield is correspondingly reduced.

The little farm in eastern Massachusetts to which I have referred is located on one of those gravelly moraines where the soil is mainly bowlders from the size of a man's head down; and it seems impossible to get the soil too wet. How my ancestors for two hundred and fifty years made a living out of that miserable soil I can not see. The land is devoted now mainly to gravel pits, which I think is the best use for such lands.

Market gardeners in the vicinity of the large cities have found it economical to install plants for obtaining water, and in a number of instances ditches have been built from the streams to cover sandy lowlands, utilizing these for production of grass and occasionally for general farming.

On such gravelly or sandy moraines as I have spoken of you can not get a good crop of grass unless the water is supplied to them all through the year.

The Geological Survey is interested in the subject of irrigation whether East or West, through its work in mapping the country, showing the location and character of the streams, and in studying waters as one of the great mineral resources of the country. In the arid West the Survey is specifically authorized to ascertain the extent to which the land can be reclaimed by irrigation. On our maps we are attempting to show, wherever the conditions are suitable, the depth of water by contour lines drawn across the map, so that anyone desiring to sink wells can determine the probability of getting water at a reasonable depth. In the East it is measuring the volume of the streams, mapping the depth of the water, and obtaining other facts bearing upon the employment of the water supply for power and for various industrial purposes, including its use in agriculture and for municipal purposes. The data which are being had are particularly important when consideration is taken of the effect which irrigating canals may have upon the flow of the stream. The State laws in the humid East guard the rights of riparian proprietors, and if damage can be shown it may be possible for an owner along the river to effectually block any extensive development of agriculture by this method. If, however, as shown by official data, the volume of the stream is not appreciably diminished, it follows that irrigation works may possibly be constructed on a considerable scale without opposition from this source.

I understand—although I am not a lawyer—that on account of the diversion of water the riparian owner can recover damages to the extent to which he is actually damaged. But if any work taking water from a stream is shown to be a matter of public interest, and the damages are not notable, then the parties can not be enjoined permanently from taking water from the stream. Of course the law on this subject may vary in different States.

There can be no question as to the benefits of irrigation as a method of enriching the soil and insuring against drought, and it is believed that when the facts are brought clearly before the farmers of the country by the work of the experiment stations and various investigators there will be a steady increase in the area of land under ditch.

In closing I would like to refer to a subject which I think has not been touched upon; that is, irrigation by sewage—by using for irrigating purposes the waste from towns. This is quite extensively practiced in the East. I have in my mind some sewage farms in the vicinity of Boston where the drainage from a small town is conducted upon sandy lands and practically filtered, the filter beds being cultivated. In this way large crops of corn and other agricultural products are raised by the almost continuous application of this sewage. Of course a work of this kind involves technical as well as agricultural skill in handling the water and selecting soil adapted for this sort of irrigation, soil which can receive an immense amount of water without being injured.

C. S. Plumb, of Indiana. At our experiment station we feel the need of water exceedingly during a dry spell on account of a very deep layer of gravel which comes quite close to the surface.

E. B. Voorhees, of New Jersey. We have one or two irrigation plants in our State on land which lies low and is underdrained, and the water from below affords the necessary supply of water in a dry season and carries it away in a wet season.

A delegate called attention to the system in use at the Louisiana Experiment Station by which water may be pumped through drains for the purpose of irrigating, and the same drains carry off the excess of water in a wet period.

E. B. Voorhees (in reply to a question). We have obtained our best results on light sandy soils, but I can not say that we would not have good results on heavier soil with similar crops. My impression from the work we have done is that better results can be obtained from lighter soil on account of greater ease of distributing the water—the readier flow of the water in the soil.

H. J. Waters, of Missouri. Mr. Chairman, we have had some experience in irrigating very heavy, compact clay soils which are retentive of moisture and which cake very readily. At first we almost despaired of success; that is to say, after our first trial it seemed that it would be impossible to prevent this caking. We found, however, that when irrigating such a crop as strawberries we left the mulch on and flooded under it, the trouble from caking was entirely obviated, and the good results were very marked. So also some nursery trees proved to be crops that could be profitably irrigated. On the irrigated portion of a given tract we were able to produce with one irrigation No. 1 stock, but on the unirrigated portion no stock of this quality was produced. This was on the typical upland silt clay of Missouri.

C. S. PLUMB, of Indiana. About fifty years ago, I believe, there was a man named Cole, who did a great deal of irrigating work in New York State, not far from Elmira. I believe he published a book on irrigation. I would like to know something about that method of irrigation, if anyone here can inform me.

E. MEAD. I have read the book; there was nothing peculiar about the system that anyone would care to adopt at the present time. He employed subirrigation by means of trenches very largely. The methods employed now represent more experience and a better understanding of the subject. That was one of the earlier attempts; and, like all earlier attempts, has been improved on later.

A DELEGATE. Has subirrigation been generally satisfactory?

E. MEAD. It is pretty hard to answer that question, yes or no; the general practice at the present time is to use surface irrigation. The general belief at present is that subirrigation does not pay.

Supplementing what Professor Voorhees has said about heavy soil, I wish to say that in the East, where we may always expect rains, a good deal would depend, in comparing results, on whether it was a heavy or light soil which was being irrigated.

The results this year throughout the Mississippi Valley, where they have had a prolonged drought, show much larger returns from the irrigation of heavy soil. Heavy soil suffered more severely than light soil from drought, and the benefit of the application of water upon heavy soil was correspondingly greater. The system of irrigation which has been referred to in Louisiana is on an exceedingly heavy clay soil, and the results have been excellent.

R. H. Forbes, of Arizona, read the following paper:

RANGE IMPROVEMENT AND ADMINISTRATION.

In a country of small rainfall the first essential is to secure and make maximum use of the available water supply. This applies not only to irrigation farming, but to the administration of grazing ranges. But the intensive methods of the irrigator are not suitable to the open range, and we must find other expedients which are applicable to an extensive situation.

In our semiarid Southwest, with but 4 to 20 inches annual rainfall, nature and nature's children have given beautiful demonstration of the methods best calculated to conserve and utilize a scanty water supply.

In the first place, quick-growing and drought-resisting forms of vegetation have been developed, which not only make prompt use of the occasional rainfall, but which also cling tenaciously to the moisture thus secured. Certain grasses, for instance, mature seed in less than two months' time; while many forms of vegetation grow quickly when it rains, then, when moisture fails, relapse into a waiting quiet, which is not death. Most desert plants also have some expedient by which to resist loss of moisture by evaporation. Some diminish their leaf surfaces to a minimum; others contract their mass into rounded forms; still others coat themselves with hair or varnish, and some charge their juices with hygroscopic substances.

Many other forms of vegetation of more luxuriant habit make ends meet, not by restricting expenditures, but by increasing their income. Such develop extraordinary root systems in search of a larger water supply, or seize upon those situations where water is locally more plentiful. This latter class of more succulent and luxuriant forages occurs naturally at lower levels, where drainage water gathers and sinks into the soil. The swales and valleys of our semiarid region are therefore filled (or once were) with a growth of saccaton, mesquite, etc., which in that situation obstructed the run off from higher slopes, thus causing an increased downward seepage, which redounded to the benefit of valley vegetation. Not this only, but these obstructive tactics caused deposition of storm water silts at lower levels, resulting in the building up of broad, gentle swales of increased water storage and vegetal capacity.

The beaver, following suit, built his dams across the meager streams, and did his part in restraining the run off of some districts. Last and least of all, the wild Papago, throwing his embankments across shallow mountain washes, restrained sufficient water to grow crops of corn and beans.

On such a plan nature kept the water in the country, and heavy floods were usually restrained and absorbed into the underflow of the valleys long before they reached the few open water courses.

But then came the stockman, with his destructive herds rudely interfering with this nicely balanced order. Excessive numbers of cattle destroyed the upland grasses and depleted the vegetation of the swales. In passing to and from the few watering places countless hoofs wore deep paths from higher to lower levels; and then the rains, unrestrained by range cover, collected quickly into violent, erosive floods, which not only carried the water completely away from the country formerly benefited thereby, but, deepening the trails and roads into murderous gullies, destroyed the very formation which made the retention of water and the growth of the more luxuriant forages possible.

So now the grass is scant; the seed is blown and washed away; the main valleys are gutted; the beaver are gone; and the live-stock industry is left to live or perish according as it does or does not solve its self-imposed problems.

The first of these problems is a scientific and engineering one, and is simply to follow primeval nature and keep the water in the country. The second and equally important problem is a legal one, and is to administer the free range on nondestructive principles.

As to the solution of the first problem, the first step, manifestly, is to exclude grazing animals from the range and allow nature to resume sway, restock with native grasses, and reestablish her original order. This work of reconstruction may be materially, and possibly economically, aided by such operations as the sowing and harrowing in of native seeds where most needed, an essential consideration being to treat large and properly distributed areas at little cost.

Also, of possible utility is the assistance of nature in water restraint by means of numerous small, cheaply constructed embankments so placed upon the gradients of our desert country as to catch and hold the storm-water run off.

Again, the work of introducing new desert forages is of possible utility; but the main consideration—the one toward which all the operations of the semiarid range reclamation must tend, either by natural or artificial processes, is that of water conservation. This accomplished, the growth of abundant forage, either native or introduced, easily follows.

For the past two years the Arizona Station, part of the time with the cooperation of the Division of Agrostology, United States Department of Agriculture, has been studying the aspects of range reclamation alluded to above. As it now stands, our 350-acre range reserve begins to show interesting results along all three of the lines alluded to above.

(1) The exclusion of horses and cattle is conspicuously evident along any of the fence lines of the reserve.

(2) The value of the embankment idea (originally suggested to us by the primitive operations of the Papagos) is beginning to be apparent. The upper 4 or 5 acres of the reserve, across which some six or seven embankments had been thrown by means of a plow, was, after last summer's rains, probably the greenest bit of mesa range in our whole valley. Following this clew, we are continuing with a quantitative study of the utility of the idea. The area of our local watershed, the rainfall, the amount of embanked ground wet by the run-off of this rainfall from this watershed, the cost of necessary work, and the value of the pasturage created are all known or knowable factors of the study, and should ultimately give us a fair notion of the utility of the idea in the great district represented by our experimental ground.

(3) As a bank holder, to prevent the washing of our earthworks in this experiment, *Lippia repens* suggests the possible utility of imported desert plants and forages. The Lippia, stated to be a valuable lawn plant in Egypt, as it has proved to be in southern Arizona, was planted by Dr. Griffiths on the upper side of one of the embankments last January. Through an excessively dry, hot season, this remarkable plant spread and blossomed, one of the greenest things in the reserve.

Such, briefly, are the leading aspects of range study and reclamation as they now appear in far-off Arizona.

The second great problem—that of range administration—can be read only by title here. Yet I venture to hope that in the not too distant future means may be devised analogous to those for forestry preservation, whereby a public range may be administered consistently with its own continuance and its legitimate use by stockmen.

Nomination of Section Officers.

The chairman announced the appointment of the following as the committee on nomination of officers of the section: B. W. Kilgore, of North Carolina; C. S. Plumb, of Indiana; H. J. Wheeler, of Rhode Island; A. M. Soule, of Tennessee, and W. J. Spillman, of Washington.

This committee recommended the following officers, who were elected by the section and confirmed by the general session (see page 63): For chairman, H. J. Waters, of Missouri; secretary, C. G. Hopkins, of Illinois.

Nomenclature of Energy of Food, Etc.

The report of the committee of three appointed by the section at the last convention to consider this question was called for.

W. O. Atwater, of Connecticut, asked that instead of presenting the report in full he be permitted to present the final conclusions and recommendations. This was agreed to, and Dr. Atwater read a part of the report, which has already been given in full on page 64, and explained briefly its scope.

The Chairman. As the chair understands, the committee asks that this section recommend to the Association as a whole the adoption of these definitions; and they also ask that the committee be continued, in an unofficial way, to pursue its work on this same subject and make such report later as may suit its convenience. The chair understands the motion before the section to be that the Association be recommended to adopt and print in their records the definitions reported by this committee and that the committee be continued.

The motion was agreed to.

Nitrification as an Element of Soil Productiveness.

W. A. Withers, of North Carolina, read the following paper on the above subject:

In some experiments which were conducted by the writer and his associate, Dr. G. S. Fraps, in continuation of those recorded in Bulletin 176 of the North Carolina Agricultural Experiment Station, certain facts were observed which appear to be of possible economic value in practical agriculture. The work will soon be published in a bulletin, but some of the results may be briefly stated now.

In the experiments 500 grams of soil were treated with 0.3 gram of combined nitrogen, and after three weeks the nitrates formed were leached out and determined. The amount of nitrates formed in a blank determination was deducted.

Some soils came under our observation which were incapable of nitrifying ammonium sulphate or cotton-seed meal either with or without the addition of calcium carbonate.

All the soils tested by us without the addition of calcium carbonate nitrified cotton-seed meal more rapidly than ammonium sulphate. With the addition of calcium carbonate some nitrified ammonium sulphate more rapidly and some less rapidly than cotton-seed meal. For example, a slightly acid soil, which was kindly furnished by Prof. W. P. Brooks, agriculturist of the Massachusetts Hatch Experiment Station, without calcium carbonate nitrified about 2 per cent of the nitrogen in ammonium sulphate and 15 per cent in cotton-seed meal, and with calcium carbonate the figures were 46 for ammonium sulphate and 33 for cotton-seed meal. On the other hand, a black garden soil, which was kindly furnished by H. K. Miller, chemist of the Florida Agricultural Experiment Station, without calcium carbonate formed no nitrates from ammonium sulphate and 17 per cent from cotton-seed meal, but with calcium carbonate formed 16 per cent from ammonium sulphate and 42 per cent from cotton-seed meal.

Calcium carbonate hastened the formation of nitrates from the nitrogenous matter in the soil. For example, a soil from the North Carolina Station without calcium carbonate formed nitrates containing 10 milligrams of nitrogen, and with calcium carbonate, during the same period, 14 milligrams.

Calcium carbonate enabled certain soils to nitrify ammonium sulphate which would not do so without it, and hastened the nitrification of cotton-seed meal in all instances. Examples of this have already been referred to.

If it be true, as is generally believed, that nitrogen is taken up by ordinary agricultural plants most largely in the form of nitrates; if it be true, as is generally supposed, that nitrates are formed in the soil only through the agency of organisms; and if also it be true that soils differ as to the organisms in them, as the experiments just referred to indicate, is it not of the greatest importance, in seeking for the different agencies contributing to the crop-producing power of a soil, to give some consideration to the organisms which it contains?

If calcium carbonate hastens the formation of nitrates from the nitrogenous compounds which are in the soil or applied to it, and in some cases with ammonium sulphate, aids this process to take place where otherwise it would not do so at all, is not the question of the application of lime to the soil worthy of more consideration than is usually given it by practical farmers?

Designations of Substations and Trial Stations.

W. M. Hays, of Minnesota, submitted the following resolution; which was adopted:

Resolved, That the chairman appoint a committee of three to consider the advisability of securing uniformity in the terms used to designate substations and trial stations, and to suggest names.

The committee appointed by the chairman is W. M. Hays, of Minnesota; W. J. Spillman, of Washington, and E. J. Wickson, of California.

W. J. Spillman, of Washington, submitted the following paper:

Quantitative Studies on the Transmission of Parental Characters to Hybrid Offspring.

In eastern Washington fall-sown wheats ordinarily yield 15 to 50 per cent more than spring sown. It happens, however, that the varieties thus far found adapted to this region are all spring wheats, though they are usually sown in the fall. Since these spring varieties do not withstand the rigors of winter nearly so well as the true winter wheats, there is a pressing demand for winter varieties. In attempting to meet this demand, we have tried something like 150 varieties, but have found none that are satisfactory. The most common defects are shattering of the grain, lodging, liability to smut (bunt), and unsatisfactory milling characters. Most of them possess all these defects, but a few have only two or three of the four.

Having failed to find suitable varieties, we have undertaken to produce them by crossing the most promising winter varieties with the leading spring varieties known to be adapted to the region. This work is only fairly begun, yet some of the results thus far secured are of such a character as to be of interest to plant breeders generally; hence this paper.

Beginning in 1899, we made 14 crosses, securing, in most instances, several grains of each cross. From these grains 215 mature plants were harvested in 1900. With a few exceptions noted below, those plants of the same breeding were similar and intermediate in character between the parent forms. A head from each was preserved for future reference, the remainder of the seed being sown. The seed of each plant was kept separate, thus giving 215 plats. Of these, 149 proved to be true hybrids; the remainder were identical with the female parent, thus showing that the flowers had been self-fertilized. This is made evident by the results below.

In each case one of the parents was of the club type (*Triticum compactum*), the other of the common type (*T. vulgare*). As above stated, no important variations occurred in the first generation except as noted below; but when the heads appeared on the second generation, a remarkable state of affairs was seen to exist. At first glance it appeared that each of the hybrids had split up into all sorts of types. But closer inspection showed that in every case but one, which is noticed later, the forms in each plat were simply combinations of the characters of the parent forms. Further inspection revealed the fact that in plats of similar breeding exactly the same types were present. This suggested the idea that perhaps a hybrid tended to produce certain definite types, and possibly in definite proportions. Accordingly, all the hybrid plats were assorted into types, and the proportion of each type determined. When these results were classified, they confirmed the above suggestion; and if similar results are shown to follow the crossing of other groups of wheats, it seems entirely possible to predict, in the main, what types will result from crossing any two established varieties, and approximately the proportion of each type that will appear in the second generation. With the exceptions already referred to, the second generation consisted of the two parent types and of all the intermediate types possible between them. For instance, when one parent had long, bearded heads, and the other short, beardless heads, the plat could be divided into 6 types; 2 of these had long heads like one of the parents, 2 others short heads like the other parent, and 2 were intermediate; and one each of these 3 groups had beards, while the other had none. In some of the crosses the parent of the common form had velvet chaff, but no beards. Here a similar set of 6 types appeared, the velvet replacing the beards. When one parent had velvet chaff of dark brown color, 12 types were possible, and were actually found; 6 of these were similar to the 6 above, and the 6 others were like them except that they had brown chaff. As might be expected, many plants occurred more or less intermediate between these types, and it required considerable care to assort the types satisfactorily. From this it seems that Nägeli's statement that 3 types tend to occur, 2 like the parent forms and 1 intermediate between them, is hardly broad enough to fit the facts in the case.[a]

The accompanying charts (I–III) show, in graphic form, the proportion in which the various types were present in several of the plats.

These charts are frequency polygons, representing graphically a portion of the percentages given in the preceding tables. From the names of parent varieties at the head of each column of diagrams, and the plat numbers under each diagram, the corresponding percentages may be found in the tables.

Appended hereto (pp. 94–98) are tables showing the same thing in percentages for all the plats that were assorted with sufficient care to be included here.[b] To show the close agreement frequently found in the proportions in which the same types occurred in different plats, let us examine the figures for three plats of the same breeding. Type I, which was like the female parent, constituted 6 per cent of one plat, 6.6 per cent of another, and 6.9 per cent of another. The percentages for the other types were as follows: II, 17.7, 17.9, and 19.1; III, 12.7, 12.4, and 13.1; IV, 40.5, 38.8, and 37.2; V, 5.7, 4.9, and 7.3; VI, which was like the other parent, 16.4, 19.5, and 19.9. The agreement is not usually so close as this, but it is fair to assume that the discrepancies are partly due to the small number of plants in each plat. They are also partly due to the fact that not a few plants were more or less intermediate between the types, and these were sometimes placed in one group and sometimes in another.

It has been stated by nearly all investigators that there is a tendency, in the second and later generations, to revert to the parent forms. It seems possible that there is a more accurate way of stating this. The types that tend to occur in the second generation, as indicated by our results, include all possible combinations of the characters of the two parents. This, of course, includes the parent forms themselves, and we find the parent forms repeated in the second generation, constituting, apparently, certain definite portions of this generation.

Another important fact that is clearly revealed by the tables of percentages is that the type that is most abundant in the second generation is the same as the first generation type, whether the latter is of the usual intermediate type or otherwise. (See below.) The exceptions to this were so rare as to render them doubtful.

It was stated above that the first generation tends to be the same in similarly bred hybrids, and is intermediate between the parents. Let us consider the exceptions that occurred. In 11 of the 14 crosses there were no noticeable exceptions. In 1 case 1 of 4 hybrids (first generation) resembled the male parent closely, and 66 per cent of the next generation was like it (Table III). In another case, 1 out of 9 in the first generation differed from its fellows only in having no velvet on the chaff. In the second generation there were, in general, 12 types in these hybrids (Table XI, Chart III, col. 1), 6 with velvet and 6 without. The plant that was devoid of velvet in the first generation produced only the 6 types without velvet in the second generation. In another cross, which was the reciprocal of the last mentioned (Table XII), 9 out of 27 hybrids were more or less irregular in one or both generations. Five of the first generation were more like the female parent, and 1 more like the male parent than usual. In each of these cases only a few of the possible types appeared in the second generation, and the type most like the previous generation was in great excess. In 2 other cases the only irregularity was the unusual preponderance of the first generation type in the second generation (Plats G19 and G22), and the absence of several of the possible types. In 5 plats of this breeding bearded forms appeared, though neither parent had beards. In every case the beards appeared on heads having the form of the parent belonging to *T. vulgare.* This probably indicates the presence of bearded parents in the ancestry of the variety used [Farquahar].

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[a] See Sachs: "Physiology of Plants," p. 783.

[b] The plats were assorted partly by the writer, partly by his associate, Prof. E. E. Elliott, but mostly by H. F. Blanchard, a senior student in agriculture; part of it was also done by others, but most of their work had to be discarded.

M.—Jones Winter Fife. F.—Little Club.

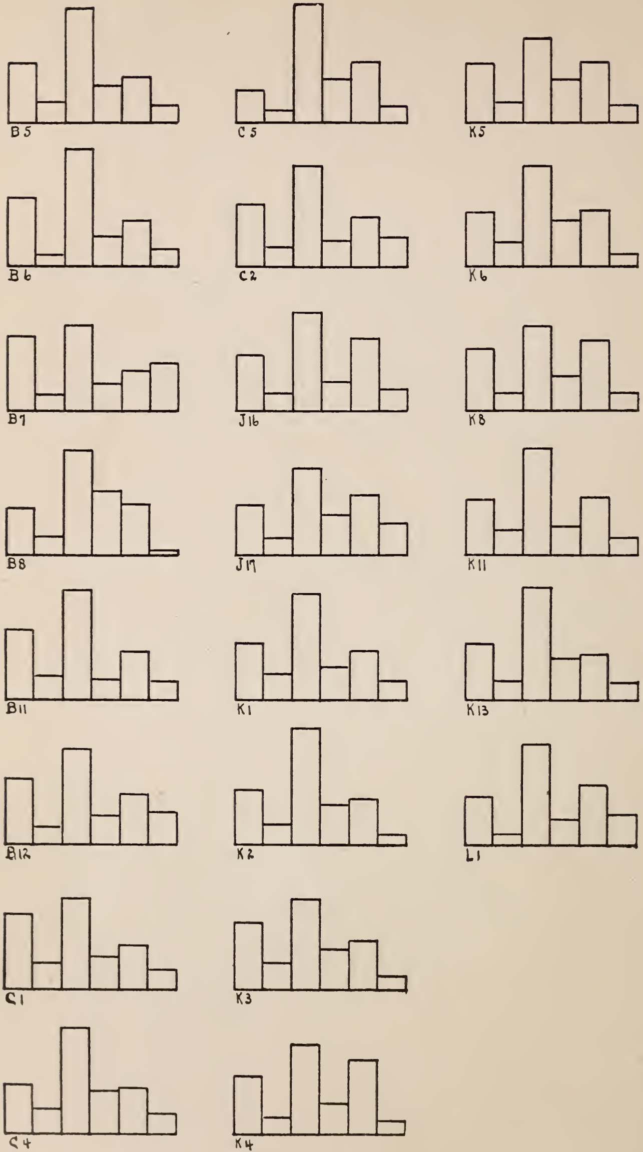

Chart I.—Showing the proportions in which the various types of wheat were found in several of the plats.

M.—JONES W. F. M.—LITTLE CLUB. M.—TURKEY. F.—RED CHAFF.
F.—VALLEY. F.—LITTLE CLUB.

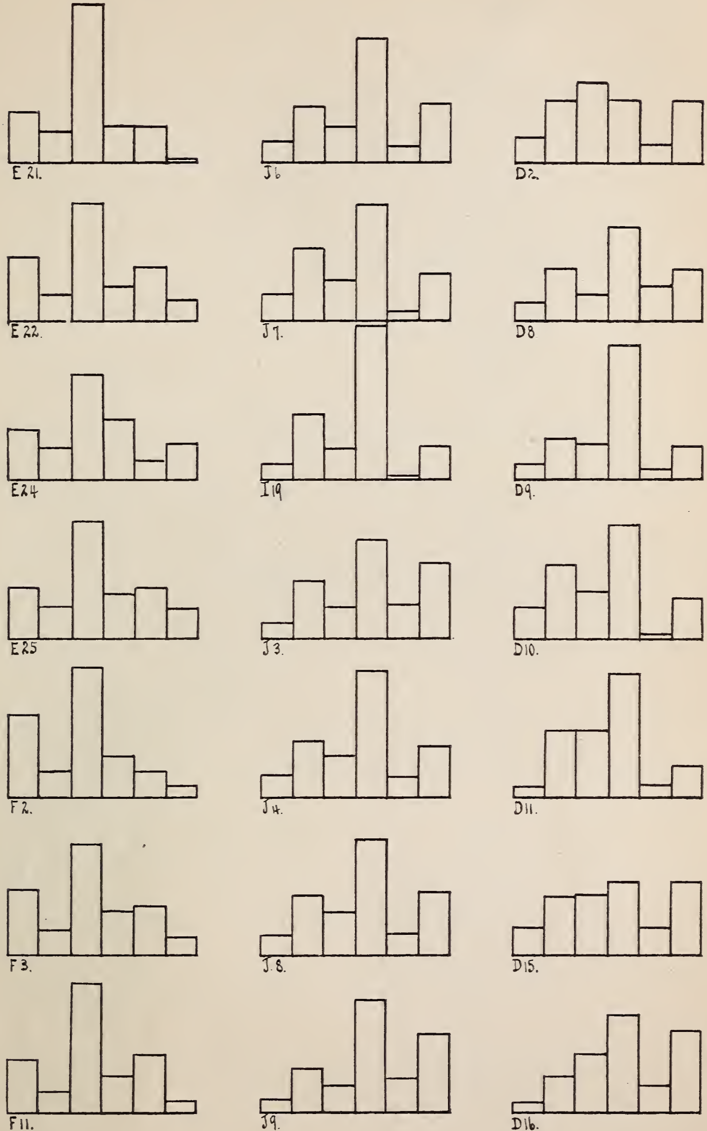

CHART II.—Showing the proportions in which the various types of wheat were found in several of the plats.

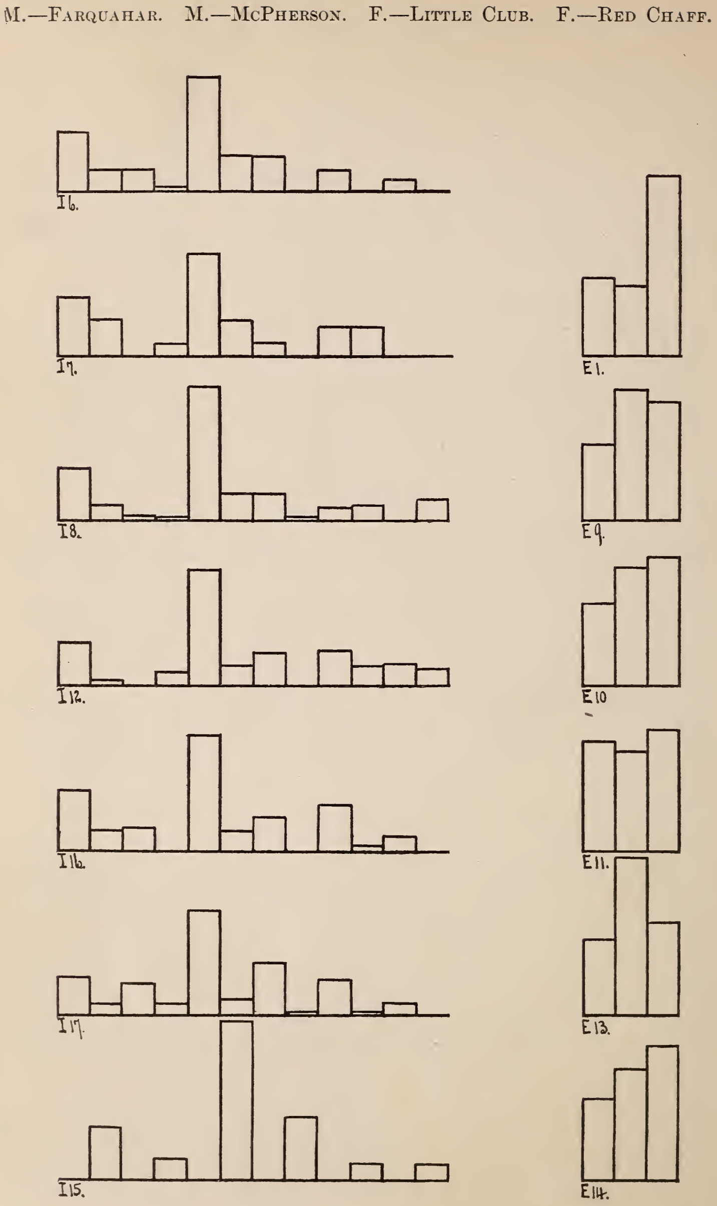

CHART III.—Showing the proportions in which the various types of wheat were found in several of the plats.

Three of the 14 crosses were reciprocals of 3 of the others; e. g., in 1 case Farquahar pollen was used on Little Club (Table XI, or Chart III; and in another, Little Club pollen on Farquahar (Table XII). Other cases are shown in Tables I and IX, and Tables IV and XIII, (Chart II). The same types appeared whichever parent furnished the pollen, and in approximately the same proportions. I have as yet not had time to study these data closely.

An immense amount of work has been done with hybrids, beginning with that of Kölreuter, about a century and a half ago. Until recently, practically all of this work was done with ornamental plants only, or with those of little economic importance. More recently much has been done with field crops.[a] The work of Garton Brothers, of England; Rimpau, of Germany; Farrar, of Australia; Hays and Carleton, of this country, and a number of others, including Vilmorin, of France; Luther Burbank, of California, and Jones, of New York, has attracted general attention to the possibilities of improvement by hybridization and selection. Most important qualitative results have been secured, the general conditions under which hybridization can be effected and the qualitative results following hybridization, were long ago formulated. They are too extensive to be quoted here.[b] Sachs remarks that Kölreuter, the first man to produce plant hybrids, covered the ground so completely that subsequent investigators have added little to his results.[c] But quantitative investigations have been too seldom undertaken. It seems to me that they are not unimportant. Prof. C. B. Davenport, of Chicago University, who has done much to stimulate interest in this direction, and to point out the great importance of such work, says in a recent article:[d] "How appalling is our ignorance, for example, concerning the effect of the mixing of races as contrasted with pure breeding. * * * In our fast-filling earth all problems will some day be secondary to that of raising more grain or beef to the acre. The biologic evolutionary problems will be recognized as paramount. It is for us to anticipate in part the demands on biology. The State experiment stations of our day are doing something in this direction, but for the most part in too narrow a fashion. For the future, broad, far-reaching experiments in evolution are required, with a quantitative study of causes and results."

While the results here reported are not sufficient to justify the positive assertion that certain quantitative laws govern the transmission of parental characters to hybrid offspring, yet they point so strongly in this direction that we may state some of these laws provisionally, looking to future investigation for their confirmation, modification, or rejection.

That similarly bred hybrids tend to be alike in the first generation, and to be intermediate between the parent forms, and that rarely an individual resembles one parent more or less closely has been stated by others.[e] We may add to this, provisionally, at least, the following:

(1) In the second generation of hybrids of similar breeding (with close fertilization) the same types tend to occur, and in definite proportions; 2 of these types are like the parents, the others include all possible intermediate forms.3

(2) With few exceptions the most abundant type in the second generation is the same as the type found in the first generation, whether the first generation was strictly intermediate between the parents or not.4

There is much evidence to show that when the parents are closely related but distinct varieties the first generation of cross-bred plants may be quite variable; yet all the above tentative laws are plainly evident in many crosses between varieties of *T. vulgare*, as is shown in the work of De Vries and of Farrar.

Many other inferences might be drawn from the tables below, but time forbids at present.

The seed has already been sown that these studies may be continued in the third and later generations. It is hoped by continuing them to later generations to learn a good deal of a quantitative character regarding the transmission of parent characters to hybrid offspring in wheats.

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[a] See Carleton's "Basis for the Improvement of American Wheats," Bulletin 24, United States Department of Agriculture, Division of Vegetable Physiology and Pathology, for statement of work on wheats.

[b] See Sachs: "Physiology of Plants, pp. 779–786; also Darwin's writings on the subject.

[c] Loc. cit., footnote, p. 779.

[d] Pop. Sci. Mo., Sept., 1901.

[e] Darwin's "Animals and Plants under Domestication," II, p. 74, Appleton's edition; also Farrar's "The Making and Improvement of Wheats for Australian Conditions," p. 5.

It is well known that types appearing in the second and later generations can be fixed by selection to type for several generations, usually five to eight; it is also important to know just what types to expect.

We have begun investigations with a view to ascertaining whether these quantitative laws extend to hybrids between other groups of wheat varieties, and whether, when a composite is formed from several varieties, all the types will appear that could be formed by combination of parent characters. It is interesting to note the possibilities that are open to the breeder should this prove to be the case. We could then produce anything we desire, if we can find varieties possessing the characters we wish to combine.

In order to utilize this principle as early as possible, should it prove true, we have selected 16 varieties scattered through several of the species of wheats, which we shall attempt to combine into a composite with certain desirable characteristics. Some of these were selected because they are winter varieties; several are large yielders; some have heavy foliage, which is important where fall wheat is pastured, and where weeds are plentiful; some have exceptionally stiff straw; some exceptional milling qualities; some are not subject to smut (bunt), and others resist rust, while several hold the grain very tenaciously.

In work of this character the larger the number of individuals the greater the probability of finding any desired combination of characters. It is therefore desirable to secure as many grains of each cross as possible and to raise all their progeny. Those who are familiar with the details of such work will realize that this entails an enormous amount of labor, and one can hardly hope for success without both patience and enthusiasm, coupled with some training.

EXPLANATION OF TABLES.

The tables give the percentage of each type found in all plats in which this was determined. The first column gives the series and number of the plats. Type I, in each case (except Table XII) is that of the parent belonging to *T. vulgare*. The last type is that of the club parent. The types are all based on certain obvious characters of the parents. In Table XII, Type IV is that of the *T. vulgare* parent, the first four types in this cross being bearded and, in this respect, unlike either parent. The figures in heavy type represent the proportion of that type most closely resembling the first generation.

ABBREVIATIONS.

In describing the types, the following abbreviations are used: l=heads long (*T. vulgare* type); s=heads short (*T. compactum* type); sl=semi-long=intermediate between *T. vulgare* and *T. compactum;* be=bearded; ba=bald (not bearded); br=brown chaff; li=light-colored chaff; v=velvet chaff; g=glabrous chaff; m=male parent; f=female parent.

Table I.

M.—Emporium; l, ba, v, br. F.—Little Club; s, ba, g, li.												
Types..	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Plat No.	l be br	l be li	l ba br	l ba li	sl be br	sl be li	sl ba br	sl ba li	s be br	s be li	s ba br	s ba li
A3	11.3	0.9	13.3	6.8	4.3	2.1	5.1	1.5	17.4	7.7	**20.9**	8.9
A4	4.0	1.0	16.2	5.8	3.3	4.3	15.2	3.0	9.9	3.7	**32.8**	8.0

TABLE II.

M.—Jones Winter Fife; l, ba, v, li.
F.—Little Club; s, ba, g, li.

Types	I	II	III	IV	V	VI
Plat No.	l v	l g	sl v	sl g	s v	s g
B5	20.3	6.9	**39.1**	12.4	15.8	5.5
B6	23.7	3.9	**40.5**	10.6	15.7	6.7
B7	25.6	5.2	**29.2**	9.3	13.9	16.7
B8	15.9	6.5	**36.0**	22.7	17.5	1.4
B11	24.2	8.4	**37.3**	6.9	16.7	6.5
B12	22.7	5.9	**33.0**	10.0	17.2	11.2
C1	26.4	8.8	**31.2**	12.0	15.0	6.6
C4	17.5	7.9	**36.6**	14.6	16.3	7.3
C5	11.2	4.3	**42.5**	15.1	21.8	6.1
C2	22.0	7.0	35.0	9.0	17.0	10.0
J16	18.7	6.2	**34.0**	10.3	24.6	6.8
J17	17.0	6.3	**29.8**	14.4	21.2	10.6
K1	19.3	8.1	**36.8**	11.7	17.1	6.7
K2	19.0	7.1	**39.9**	13.6	16.2	4.1
K3	22.9	9.1	**32.0**	14.3	16.7	4.7
K4	19.8	6.5	**31.1**	10.8	26.3	5.3
K5	21.3	6.8	**29.0**	15.0	21.8	6.0
K6	18.9	8.3	**35.1**	16.1	18.6	3.8
K8	22.4	5.7	**29.2**	12.5	24.5	5.7
K11	19.1	8.0	**37.4**	9.8	19.9	5.8
K13	18.8	7.4	**39.4**	13.8	14.8	5.8
L1	17.4	4.1	**35.3**	9.3	21.2	12.2

TABLE III.

M.—White Track; l, ba, g, li.
F.—Little Club; s, ba, g, li.

Types	I	II	III	IV
Plat No.	l	ls-l	sl-s	s
C7	**66.0**	5.5	18.3	8.9
C8	30.9	7.7	**45.7**	16.4
C11	22.6	5.9	**52.8**	18.7
C12	27.1	**47.5**		25.4

TABLE IV.

M.—Valley; l, be, g, li.
F.—Little Club; s, ba, g, li.

Types	I	II	III	IV	V	VI
Plat No.	l be	l ba	sl be	sl ba	s be	s ba
C16	3.4	39.0	2.4	**37.6**	8.2	8.8
C18	8.5	11.9	12.7	**40.6**	6.0	19.5
C21	14.3	23.8	16.6	**38.0**	5.0	2.4

TABLE V.

M.—White Track; l, ba, g, li.
F.—Red Chaff, s, ba, g, br.

Types	I	II	III	IV	V	VI	VII	VIII
Plat. No.	l br	l br-li	l li	sl br	sl li	s br	s br-li	s li
C10	4.4	20.6	9.5	**38.4**	11.1	5.0	3.2	7.0
C13	12.0	5.8	8.8	**18.0**	31.1	10.4	4.1	9.8

TABLE VI.

M.—McPherson; l, ba, g, li.
F.—Red Chaff; s, ba, g, br.
Color of chaff disregarded in sorting.

Types	I	II	III
Plat No.	l	sl	s
E1	23.6	21.6	**55.0**
E9	22.8	**40.0**	37.3
E10	25.1	**35.9**	39.0
E11	33.0	29.7	**37.3**
E13	22.9	**49.0**	28.1
E14	25.0	**34.0**	**41.0**

TABLE VII.

M.—Jones Winter Fife; l, ba, v, li.
F.—Red Chaff; s, ba, g, br.
Color disregarded in sorting.

Types	I	II	III	IV	V	VI
Plat No.	l v	l g	sl v	sl g	s v	s g
E21	15.7	10.2	**50.5**	11.6	11.6	0.7
E22	20.0	8.0	37.0	11.3	17.4	6.3
E24	15.6	9.9	**33.1**	19.2	6.3	13.5
E25	16.5	9.7	**37.0**	14.5	16.5	8.7
F2	25.7	6.9	**41.6**	13.2	8.4	4.3
F3	20.6	8.1	**34.9**	13.7	16.2	6.5
F11	17.3	6.8	**41.4**	11.7	18.4	4.5

TABLE VIII.

M.—Farquahar; l, ba, v, br.
F.—Red Chaff; s, ba, g, br.

Types	I	II	III	IV	V	VI
Plat No.	l v	l g	sl v	sl g	s v	s g
F23	23.4	8.1	41.6	12.2	11.8	5.4

TABLE IX.

M.—Little Club; s, ba, g, li.
F.—Emporium; l, be, g, br.

Types.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Plat No.	l be br	l be li	l ba br	l ba li	sl be br	sl be li	sl ba br	sl ba li	s be br	s be li	s ba br	s ba li
F26	1.0	3.5	8.5	5.7	3.4	0.0	**34.1**	7.4	11.9	3.4	**11.9**	9.1
F30	4.8	1.6	16.0	3.2	9.2	2.4	**19.2**	2.8	9.2	2.8	**20.0**	5.2
F31	.7	0.0	11.6	8.1	7.0	1.0	**10.5**	5.8	0.0	14.0	**21.1**	14.0
F32	2.7	4.9	15.0	5.5	7.0	1.0	**13.1**	7.2	10.4	0.0	**23.7**	9.7
G1	10.4	.8	10.4	6.4	8.0	0.0	**6.4**	5.6	0.0	0.0	**20.0**	20.8
G3	8.3	2.9	10.7	7.8	3.3	1.6	**19.0**	4.6	1.0	6.9	**29.0**	5.0

TABLE X.

M.—Lehigh; l, be, g, li.
F.—Red Chaff; s, ba, g, br.

Types.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Plat No.	l be br	l be li	l ba br	l ba li	sl be br	sl be li	sl ba br	sl ba li	s be br	s be li	s ba br	s ba li
F13....	1.7	3.9	13.8	0.0	12.1	1.3	**38.0**	19.0	3.5	0.0	5.2	1.7
F15....	2.0	4.5	13.5	1.5	7.7	5.0	**26.3**	12.7	6.4	4.7	7.0	4.7
F17....	5.0	1.0	13.5	5.2	10.0	10.0	**37.5**	3.8	0.0	0.0	5.0	3.0

TABLE XI.

M.—Farquahar; l, ba, v, br.
F.—Little Club; s, ba, g, li.

Types.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Plat No.	l br v	l br g	l li v	l li g	sl br v	sl br g	sl li v	sl li g	s br v	s br g	s li v	s li g
I6	17.7	6.9	7.2	2.3	**35.3**	10.8	10.9	0.0	6.8	0.0	3.5	0.0
I7	18.2	11.3	0.0	4.5	**31.3**	11.3	4.5	0.0	9.1	9.1	0.0	0.0
I8	16.4	4.8	2.4	1.2	**40.8**	8.4	8.4	1.2	3.6	4.8	0.0	7.2
I12	13.4	2.4	0.0	3.7	**35.4**	6.1	9.8	0.0	11.0	6.1	7.3	4.9
I16	18.0	5.6	7.0	0.0	**34.7**	5.6	9.7	0.0	13.8	1.4	4.2	0.0
I17	11.7	2.6	10.4	3.9	**32.5**	5.2	15.6	1.3	11.7	1.3	3.9	0.0
I15	......	15.9	......	7.3	....	**47.6**	......	19.5	......	4.9	......	4.9

TABLE XII.

M.—Little Club; s, ba, g, li.
F.—Farquahar; l, ba, v, br.

Types.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
Plat No.	l be br v	l be br g	l be li v	l be li g	l ba br v	l ba br g	l ba li v	l ba li g	sl ba br v	sl ba br g	sl ba li v	sl ba li g	s ba br v	s ba br g	s ba li v	s ba li g
G4	......	......	....	....	21.0	6.6	5.6	1.0	**25.1**	7.0	9.6	1.3	15.7	3.0	3.5	0.8
G5	......	......	....	....	17.0	3.0	4.1	2.4	**36.3**	1.0	13.0	.....	6.5	1.0	4.7	......
G13. ..	......	......	....	....	15.6	5.2	4.7	.....	**30.2**	7.8	8.3	4.7	12.0	3.1	6.3	......
G14 ...	......	......	....	....	20.0	6.7	13.3	.....	**23.3**	......	13.3	.....	13.3	.....	10.0	......
G16 ...	......	......	....	....	15.8	7.3	6.0	.....	**29.0**	8.7	9.9	.8	14.1	.....	3.8	1.0
G18 ...	......	......	....	....	13.9	5.1	......	4.2	**32.2**	8.3	11.0	4.9	13.4	2.9	3.9	......
H2	......	......	....	....	12.8	4.0	5.6	2.4	**38.4**	16.0	9.6	4.8	3.2	3.2	......	......
H6	......	......	....	....	15.1	4.0	1.0	3.0	**24.2**	11.1	10.1	5.0	10.1	4.0	9.0	3.0
H7	......	......	...	....	16.3	4.6	1.0	1.8	**32.0**	11.0	7.1	2.8	10.3	7.8	1.4	1.0
H8	......	......	....	....	22.1	7.0	4.5	.....	**26.6**	15.0	8.1	2.3	11.0	3.4	......	......
H9	......	......	....	....	20.3	......	5.1	.....	**33.0**	......	9.4	2.5	9.4	16.1	2.1	1.0
H10 ...	......	......	....	....	11.3	4.2	3.4	2.3	**28.2**	11.7	7.7	2.8	16.2	5.4	4.8	1.7
H11 ...	......	......	....	....	12.7	5.9	3.6	.....	**28.2**	13.2	12.7	3.6	9.5	3.2	6.4	1.0
H12 ...	......	......	....	....	13.5	5.4	3.4	1.3	**30.2**	7.4	9.1	1.7	16.6	6.8	1.3	1.7
H14 ...	......	......	....	....	15.1	3.2	8.7	.8	**16.6**	4.7	11.1	1.5	**23.8**	10.3	2.3	1.5
H15 ...	......	......	....	....	17.0	6.5	7.0	.....	**25.0**	7.5	6.0	2.5	7.0	4.0	13.0	4.0
H16 ...	......	......	....	....	12.2	2.0	6.1	2.0	**23.0**	16.9	10.1	2.0	16.2	4.7	4.1	.7
H17 ...	......	......	....	....	14.7	3.5	5.6	1.3	**18.8**	......	......	6.3	**27.2**	11.2	7.0	......
G20 ...	......	......	1.4	1.0	1.0	8.5	19.3	2.4	**29.2**	11.6	13.2	4.8	7.2	1.8	2.4	......
G7	1.0	30.2	....	....	**53.6**	16.2	......	.....	......	......	......	.....	......	.....	......	......
G9	14.0	8.0	....	....	**61.0**	12.0	......	.....	1.0	......	......	.....	......	.....	3.8	......
G15 ...	......	......	....	....	**56.7**	11.2	21.9	6.5	......	......	......	.....	1.0	.....	2.7	......
H1	......	......	....	....	**68.7**	......	......	.....	18.7	6.2	6.2	.....	......	.....	......	......
G11 ...	27.3	1.0	1.0	....	1.0	16.6	**53.4**	1.0	......	......	......	.....	......	.....	......	......
G22 ...	......	......	....	....	25.0	......	......	.....	**75.0**	......	......	.....	......	.....	......	......
G19 ...	......	......	....	....	1.0	1.0	22.0	.....	**76.0**	......	......	.....	......	.....	......	......
G21 ...	......	......	1.7	....	27.9	......	1.0	.....	......	......	......	.....	......	1.0	**68.3**	......

Table XIII.

M.—Little Club; s, ba, g, li.
F.—Valley; l, be, g, li.

Types	I	II	III	IV	V	VI
Plat No.	l be	l ba	sl be	sl ba	s be	s ba
J6	6.6	17.9	12.4	**38.8**	4.9	19.5
J7	7.7	22.7	13.4	**37.4**	3.0	15.5
I19	5.4	20.9	10.1	**50.0**	2.1	11.4
J3	4.7	18.1	10.0	**31.8**	11.5	23.6
J4	6.9	17.7	12.7	**40.5**	5.7	16.4
J8	6.0	19.1	13.1	**37.2**	7.3	19.9
J9	4.2	14.5	8.4	**36.0**	10.8	**25.3**
J10	3.7	13.7	17.5	**36.2**	3.7	**25.0**
J12	12.5	8.3	20.8	**37.4**	8.3	12.5
J13	5.4	21.9	7.1	**29.6**	7.1	28.5
J14	5.5	22.2	11.1	**31.0**	7.7	22.2

Table XIV.

M.—Turkey; l, be, g, li.
F.—Little Club; s, ba, g, li.

Types	I	II	III	IV	V	VI
Plat No.	l be	l ba	sl be	sl ba	s be	s ba
D2	8.3	19.6	26.2	**20.2**	6.1	19.6
D8	5.6	17.4	8.3	**29.7**	12.2	16.6
D9	5.2	18.4	17.5	**43.3**	4.4	11.4
D10	10.2	23.4	15.4	**35.7**	2.1	13.2
D11	3.1	21.6	21.8	**39.3**	3.8	10.5
D15	9.0	17.9	19.0	**22.8**	8.6	22.6
D16	2.6	12.2	17.7	**31.0**	8.8	26.7

Variation in Cross-Bred Wheats.

W. M. Hays, of Minnesota. The most important thing in breeding is that we get at general laws. It is desirable that we should get at general facts if we intend to incorporate them into practice and raise the standard of our wheat and other crops and our live stock to a point perhaps 25 per cent better than at present. I believe it conservative to say that something like this can be accomplished—that we can increase our wheat 25 per cent in value per acre, improving both the yield and the quality; that we can increase our corn the same way 25 per cent per acre, and that we can increase the value of our domestic animals so that the net returns from these may be 25 per cent better than at present.

I believe we can do this in fifteen years. It does not take long to breed a variety of wheat. Even if it takes us ten or fifteen years, it is time and labor well spent.

In my experiments I have sought to follow the advice of our great experimenters and not confuse myself with too many problems. I have tried to produce new varieties. I have tried to learn from practical experience from year to year how to make these new varieties. I have made some theoretical experiments, but not many.

Since I knew of no particular laws which would tell me how to get important results at once, I drifted into using individual plants and learning how to measure their value. The important thing to be done, according to my mind, is to learn the value of individual plants, not by the performance of particular plants, but by the performance of a given number of its progeny—the average ability, the average yield—in fact, the average of its general value—the average value of its product.

For instance, I would measure the value of the mother plant by the averages of 100 plants grown from each mother.

This principle has proved true in experimentation in the production of varieties, especially of wheat. I will not go into the details. It occurs to me that we have very good evidence that there are individual plants and individual animals in each species and variety which are like the horse Messenger, by whom perhaps a thousand or more thoroughbred horses have been bred in the attempt to produce a breed of trotting horses.

In the beginning, we did not know whether he could excel as a trotter; we knew that he was an extremely vigorous horse and probably could have been trained to trot rapidly; but we did not measure his ability to produce a race of trotters by his own demonstrated qualifications as a trotter.

If there are Messengers—one in a thousand or one in five thousand, or one in ten thousand—in your variety of club wheat or in your other variety of wheat that may be adapted to your purposes, you may be able to get that plant by some process of testing and selection, which simply means that you must eliminate all but one of the thousand or the five thousand or the ten thousand, and then concentrate your experiments upon that one.

If you want to reach an ideal, including all the characters that you desire, then when you come to your selection out of that ten thousand you take the plant that is worth the most on the whole—that most nearly meets all the conditions. In wheat experimentation, suppose we take the plants that are self-pollinated we have grown for at least eight years, varieties that have become large commercial stocks of wheat. You all know the varieties of apples and other crops produced by cuttings. I wish we had some term which would carry the idea of producing without sexual generation. You remember the case of Gideon's apple, raised from a single seed found among seeds from many trees. Old Peter Gideon was a New England man. He came out to the Western country and settled there with his wife. He was so poor that his wife, in order to make him a coat, had to sew a pair of pants legs onto an old vest. He borrowed $5, with which he bought a quantity of apple seeds. Out of those apple seeds one proved to be the Wealthy, which has been worth a million dollars to us in our part of the country, and is worth many millions to us as a means of stimulating us to produce something better in the way of plants.

Plants are not accustomed to self-pollination—self-fertilization. They have been accustomed through generations to cross pollination and cross fertilization. I rather believe from what I have seen—though I have not put my belief into formal data—that wheat more often goes backward than forward on the average, when you compare the average of the progeny with that of the two parents.

This is believed to be more especially true of plants that have been highly specialized away from their natural species type and where self-pollination is the natural habit of the plant. It is not true of the open-fertilized species; in fact, there self-pollination generally causes a going backward. Professor McClure, of the Illinois station, showed that to be true with regard to corn at an early day; and latterly it has been shown in many instances at the Illinois station. The average is very much reduced by self-fertilization. In the case of open-fertilized species, I dare say, we can not base new varieties on a single plant or on two plants—not on less than several plants at the lowest. So we must use in this case a different method. We must measure the mother plants or the animals in their potential relation to the blood with which they are mixed when you cross them with other individuals; and the final test is not in the nursery, but in the field. So that we can not insure results by systems of breeding. We must be sure that we send out nothing but what will yield the best by careful field testing, etc. If there is in 1,000 or 5,000 plants or animals one that has peculiar ability, we know so little about heredity and all the other factors bound up in this little organism that we must take care not to theorize too hastily—not to go beyond the facts ascertained. We must discriminate as a mere matter of business until our knowledge of the subject increases. We can not discriminate; we must measure. We must adopt some method of finding out these individuals that have this power of increasing the values of a variety when multiplied in useful quantities.

In regard to large plants, like corn, the farmers themselves do the most effective breeding, so far as quantity is concerned. The Illinois station has illustrated to us in a measure what may be done in the matter of quality. We must have cooperation between the station and the farmer. In this way wonderful things are being done in Illinois. We thus get quality and quantity; and we get other characteristics, some of which increase the value per acre. But in cases like the Kentucky blue grass, or even wheat or white clover, where the plants grow and intermingle, we must, in order to study the individuals, plant them separately. In the first place, we must select strong individuals, and we must get the average value of these plants—not simply the value in individual cases—the average from an economical standpoint, so far as we can judge, that we may use these average values as expressing the breeding value of the mother plant.

Now, we can do this in close-fertilized species rather readily; we can do it with more difficulty in the case of the open-fertilized species. The two cases call for quite different methods. I can not go into details, but it is on the different ways of doing the thing as learned by experience that I have put in a good deal of my time, rather than on formal experiments.

Now, to follow out the testing of these parents, we put in, we will say, 5,000 plants of wheat. When these plants are ready for reaping, we set a man to work with sheep shears, and he cuts out all but 4 per cent, giving us 200 plants, from each of which we harvest the seeds, planting them separately. In the laboratory we weigh them in the chaff, throwing out all but a hundred of the heavier ones. These we shell, and after weighing and grading them we throw away, we will say, all but 10, though that is probably a smaller number than we ought to have. We take each of these plants and start plats. At harvest time we pull all the plants so as to count them, and while doing this we select the best heads out of 10 of the best plants. We have a little thrashing machine through which we run about a pint of the wheat. We put together the wheat from the 10 heads, and these we test for three years. We do not positively know yet whether the period ought to be one year or three years; but at present the plan is for three years, because we want a real test in land that is uniform. This is merely a field test of these wheats of their ability to yield well. At the end of three years we simply sum up all the characters that we have recorded, selecting those that appear to have the most value. If we have started with 10 varieties, we now have 100 of these plants; and we select, say, 300 of the best plants. These stay in the field for three years. One or two or three of them will probably do exceptionally well. From the first 30 we have 8 really good ones, as compared with the standard wheat with which we started. Only 2 of these, however, we are distributing. Mr. Carlton, who had some experience in looking up wheat for the Paris Exposition, found that only one, two, or three varieties are used commercially in a State. It is a bad thing to have a large number of varieties in a single State. It is a bad thing on the commercial side—the farmers do not want a dozen varieties in any community; they want only a few, and they want none but the best. We send out these samples to the substations and to surrounding States. At the end of eight or nine years we shall have in the neighborhood of 10 or 12 or 15 tests of wheat, in comparison with certain known varieties, the yield of which we have previously established, the knowledge of which we have previously gained. Thus we can judge as to whether we want to introduce any particular variety.

Then we take these test varieties, those that are doing the best, the new varieties that come nearest to combining the general qualities that we want; and we breed them in large numbers; we make new varieties, and increase those varieties. Sometimes the best varieties are obtained from a single kernel of hybrid wheat. But whether we use one kernel or many, we make many new varieties and increase them during three or five years; and then we use those that show that they have a lot of really good plants in them, just as you might plant 5,000 original varieties in your nursery and then go to work to find the good plants among them for foundation varieties.

The great object of hybridization is to produce individual plants which in the case of these self-fertilized species you use singly, or in the case of open-fertilized species you combine the varieties—those plants which, when multiplied, will give you increased value per acre.

Now, it is an irksome job to breed field crops, and what pleases me more, I think, than anything else is the fact that I have systematized a lot of this work so that it can be done with a force of people who work for pay—and not very high pay—careful people who will carry out this work in rather a formal way, so that we are not limited to the amount of work that one man can do. We want, if possible, to carry on these operations as a large business, done in a large way, so as to get the advantage of these large numbers.

Now as to the matter of large numbers. Assuming for a moment that my proposition is true, if there is one superior plant in a thousand or several thousand, we need to produce a thousand or several thousand to get that occasional plant. A number of the plants are lost by accident; and then we may unadvisedly choose plants that are not desirable. I do not know how large a number of plants we ought to use. I do not use such large numbers as I ought to use if I were limited in my work to a few foundation stocks; but as my purpose has been to get an experience of many varieties in order to form a business plan, I have limited my number to something like 2,000, rather than use an immense number.

If you undertake to have 100,000 plants in your original plats, there is a great deal of labor in planting them; and then there is a great deal of labor in cutting them out with shears; and there is considerable labor in carrying them through a course of cultivation for three years.

In each particular case it is a question whether you shall begin with a large number of foundation stocks. In these matters we are constantly learning. I believe it is a wise thing for each plant breeder to start with a large number of varieties, so that the men working on the crops will acquire experience along these lines.

Now I want to say a few words about our method of distribution. So far as we have been able, we have done away almost entirely with the idea of giving away seeds. We try to find varieties which by one method or another will almost surely increase the yield of plants of the farmers of our State, or of some section of our State. And we select farmers who will be willing to pay for what they get. We are trying to put this matter on a commercial basis. We will distribute of the first variety, say the first year, 200 bushels—about 2 bushels to each grower—and the quantities distributed increase as the years go on. As a single farmer in any community is discovered by his neighbors to be making more out of his crop than they do, the neighborhood will soon be growing that wheat which is found to yield most. The reports made to us by the different growers are carefully preserved and compared and are valuable for guiding us in our work.

After some further discussion of the subject participated in by W. J. Spillman, C. F. Curtiss, M. A. Carlton, W. M. Hays, and others, the section, on motion, adjourned.

SECTION ON HORTICULTURE AND BOTANY.

The meetings of this section were held on the afternoons of November 13 and 14, 1901, A. D. Selby, of Ohio, presiding in the absence of the chairman, L. R. Jones, of Vermont.

COOPERATION IN EXPERIMENTAL WORK BETWEEN THE STATION AND THE FARMER.

J. CRAIG, of New York. Mr. Chairman and gentlemen, my object in bringing before you the paper I am about to read was to make some suggestions as to the method in which work of this character may be carried on. I take it for granted you agree with me that cooperative work between the station and the farmer is desirable. This class of work, as I understand, and I think as you understand, is not of the highest type of scientific endeavor. It does not attempt to go into those problems which require the machinery of a laboratory, or which call for the trained faculties of experienced observers. It aims to demonstrate and illustrate facts already discovered in your laboratories—to bring these facts in the most effective way before the farmer.

The question is not, Is it advisable? We are probably all agreed that it is; but to what type of investigations should it be confined, and how should cooperative work be carried on? We shall probably agree that certain kinds of investigation work can be conducted only in the laboratory or on the station grounds and under the eye of the station worker. The results thus obtained frequently require verification and demonstration by trials made on a larger scale and under less ideal conditions. In most cases they also, from the standpoint of the farmer, need practical illustration. The ultimate object of the station man's labors is the enlightenment of the farmer and the advancement of agricultural practice. When experiments in which the farmer cooperates with the scientist are conducted, we bespeak the influence of a factor—the farmer—having considerable advertising value. The results, be they negative or positive, are the more readily diffused in that immediate locality. An important part of the investigator's task has been accomplished.

Abstractly considered, therefore, cooperative experiments of the character suggested are valuable aids to the experiment station scientist. Are they, however, practically successful? If not, what are the difficulties? Perhaps these might be summarized under two heads: (1) The difficulty of finding the individual possessing the desired mental attitude—in other words, an unbiased juryman; and (2) the difficulty of having small but important details attended to at the right time; carelessness in observation; looseness in measuring final results.

In this summary I have not raised a suspicion that the methods of the station representative are anything but thoroughly correct and perfectly orthodox. The onus of failure rests on the other fellow. Let us, for the sake of argument, suppose that the weakness rests solely with the farmer. How may it be strengthened? I shall take the liberty of making a few suggestions, which are offered primarily for the purpose of assisting discussion on a topic of considerable importance.

(1) Let the issue be practical.

(2) Do not force an experiment on a man.

(3) Always have a written contract which requires specific things.

(4) Pay liberally for the use of brains personified in accurate observations and good judgment, and fairly for manual labor.

(5) Visit the experiment plat often enough to keep in personal touch with the progress of the investigation.

(6) Make only the financial consideration a personal matter between the station and the cooperator; rather let the latter feel responsibility by giving publicity to the purpose of the experiment and credit for his connection and assistance.

P. H. Mell, of Alabama. Mr. Chairman, as I understand the point that Professor Craig makes, it is, not to force experiments upon any special individual, but to so present this work that the people will naturally take hold of it and pay attention to it themselves, and will indeed call for the privilege of carrying on these experiments.

Another point which he makes is, I think, important. I think we often make the mistake of permitting the station to absorb too much of the credit for the work. I believe the individual carrying on the work ought to be given all due credit; more than that, he ought to feel the responsibility of his work so that when he has completed it he may feel that the work is his and that he is to have the credit for it. The paper which has just been read strikes me as a valuable one and one which we ought to take up and discuss.

L. C. Corbett, of the United States Department of Agriculture. This is a line of work which I found very profitable in West Virginia, where there is such diversity of climate and soil conditions. The horticultural region there is very distinctly divided into two or three sections, each of which has a peculiar soil; and the climate of one section is very different from that of the others. It was my aim in planning any cooperative experiments to confine them purely to the local problems of the region. For instance, in one region where bitter rot made serious inroads, the work was confined entirely to dealing with that disease in the various orchards. In another section, where peach growing was very extensively engaged in, we carried on a series of fertilizer experiments with peach trees, beginning at planting time, in order to ascertain the effect of different kinds of fertilizers upon the growth of the trees and the color and quantity of the fruit. In all this work, in which the farmers have been asked to cooperate, I have endeavored to keep strictly in mind the selection of some problem which was a local problem, in which the farmers of a particular section were especially interested. I believe that in this way the experiment station may often do very much greater good for their constituents than can be done at a central experiment station, particularly where there is much diversity in the character of the work undertaken. It was my object always to go into the region where the particular fruit to be studied seemed to thrive. In doing this, I did not necessarily wait for a special request. In the case, for instance, of the bitter rot, I went into an orchard region and found that late in the season bitter rot had broken out where it had never occurred before. Before leaving that region I made preliminary arrangements to conduct experiments there the next season. The people there were familiar with the work of the station, and they were very glad to have the experiment carried on. It required no argument or persuasion on our part to get them interested.

But we experienced some difficulty in getting the work satisfactorily carried out. I think that in nearly all this work some provisions should be made so that the experiment station can at all times have the liberty to institute the work where necessary and have supervision of it.

If we had knowledge of the outbreak of any disease among the fruits of any region, or if we happened to ascertain any means by which the business could be made more profitable in a particular region, then I should go out in a missionary spirit, with an idea of bettering the conditions in that region; and I would carry on illustrative experiments for that purpose. In case of some experiments with peaches, I think the suggestion came primarily from the experiment station. Our action was not solicited by the people, although we found them very willing to enter into cooperation with us.

Whether it would be possible to carry on other experiments than fertilizer experiments and spraying experiments, I have grave doubts, particularly as to experiments along horticultural lines.

J. S. Newman, of South Carolina. Mr. Chairman, my experience during seventeen years has been a little different from that of Professor Craig as to the financial part of this work. I found that men not at all suited for the work would take hold of it if we paid them for it; but from such workers we would not get good results. I found that the best way was to find out, in a particular neighborhood, the men who were naturally disposed to experiment in their own work—who were fond of it. Men of that sort will take hold of the work with vim, without any pay, provided no expense to them is involved. I have gotten very good results from the distribution of varieties of strawberries, etc., in sections where they had not been cultivated. We would give instructions how the fruit was to be handled. In that way we found that we could get into touch with the farmers. They would generally be interested in any work of this kind that was going on in their neighborhood. One requirement we made, for instance, in respect to grapes and strawberries, was that when the vines were pruned the cultivator was to give cuttings to his neighbors. In this way we established hundreds of vineyards where none existed before. The farmer will more readily imitate an experiment carried on upon his neighbor's farm than one attempted on the station farm, because I suppose the idea prevails everywhere that the station has unlimited means at its command, and can do things which the farmer can not imitate.

The selection of the right man to do the work I consider of the first importance, and I have found that we get the wrong men when we offer to pay them. Men who were totally unfit for the work, who seemed to care for nothing except the money, would conduct an experiment which proved to be utterly worthless.

P. H. MELL. In Alabama, where a great deal of cooperative work has been carried on in connection with what is called soil test work, the men at the station have succeeded in getting the cooperation of good men on the farms by visiting the localities and talking with the people and getting the opinion of farmers living in the neighborhood.

We do not pay salaries. We simply pay the expenses of the work—the cost of fertilizers or other materials. We have found that in many cases where, by visiting localities, the interest of the neighborhood is aroused, the people are anxious to have farmers' institutes, and they send to the station for men to conduct those institutes. This gives the station men an opportunity to talk, and to have the experiments conducted on farms in that vicinity.

The experimenter who has under his charge the work of any particular locality, is required by the station to visit that locality at various times during the year to see that the experiments are carried on according to the requirements. In this way attention is attracted to the work conducted by the station, and the results are exceedingly valuable.

A. D. SELBY. In Ohio we have two lines of cooperation, both of which happen to be connected at present. There is an organization known as the Agricultural Students' Union, consisting of those connected with the experiment station, and the Agricultural School of the State University. The object of the Students' Union is to secure cooperation for the local demonstration of what has already been ascertained and proved.

The work of the experiment station has been planned to reach vital problems in the districts of the State where there are dominant industries that are suffering from particular diseases.

The work with reference to peach-leaf curl was carried on almost entirely by cooperation. The same plan has been pursued with reference to other diseases. Our plan has been, as a rule (because we have more demands upon our resources than we are able to comply with), to wait until a community has become interested in a particular question before undertaking experiments.

The expense of carrying on this work is borne by the experiment station. Of course, the remuneration in the form of improved crops to the man who cooperates may amount to a good deal. In some of the work of the present year it amounts to the difference between practically no return and a return of $125 an acre from the vineyard of the cultivator. In this case, of course, the cultivator feels amply repaid.

J. S. Newman. I was at work for eight years in Alabama, and introduced this cooperative work there. In the early history of the work I sent out to each cooperator fertilizers already prepared, to be applied, and a diagram bearing a number corresponding with the number upon the fertilizer. Having taken such precautions, I thought there could not possibly be any misunderstanding. At the same time we had a large number of varieties of seeds. We thought it best that one man should try two fertilizers on the same seed. I sent out careful instructions that all the factors must be the same. But on visiting one of these local cooperators I found that in one case he had put several varieties of seed on his fertilizer plats, so that we could not learn anything of the effect of fertilizers on different seeds.

Another requirement was that there should be no tree within 100 feet of the experiment ground; but upon examination we found a large tree in one corner of the fertilizer plats.

J. Craig. In one case in my experience with fertilizer work, last year, 13 samples of fertilizers were sent out, each of which was supposed to be put upon stock on different plats in a certain way. One cooperative experimenter thought it would be a good way to mix these fertilizers all together and put them on a single plat, which he did, so that the experiment was entirely worthless.

But I wish to say that one factor which we have found of great importance in our work is the interest of the farmers of the vicinity in the work, and, through them, forcing a responsibility on the man who is carrying on the work. Perhaps we have exceptional means for making the man feel the responsibility. In consequence of the distribution of "Correspondence Courses," we have a certain number of reading clubs in different parts of the State; and these clubs we have found in our practice to be very useful agents in carrying on these experiments. In many cases the farmers of the reading clubs will select one of their number and make him the experimenter. He then feels responsible to the members of his club for carrying out the experiments in the right way. In this way we are helped very much. Knowledge as to these experiments is disseminated very thoroughly among the members of the club. They keep an eye on the experiments and are instructed thereby. They also keep an eye on the way the experimenter is carrying out our instructions. Thus there is a sort of double incentive to good work.

W. H. Jordan, of New York. Mr. Chairman, I know that there has been very great interest among the farmers in some sections of the country where this cooperative work has been carried on; but such is not always the case. Let me give an illustration. In one of the earlier experiments a man was paid for conducting the experiment and was instructed to explain to the farmers who might inquire of him the methods pursued, the fertilizers used, etc. At the end of five years his neighbors, who had previously shown very little interest in the matter, noticed that he was getting ahead of them decidedly in the quality of his crops. They began then to make various inquiries, and he refused to make any explanations to them. He said that he had been engaged for five years in trying to explain to them, and further than that he was not going to do so at present.

Germination of Kentucky Blue Grass.

E. Brown, Seed Laboratory, United States Department of Agriculture. Mr. Chairman, the subject of the germination of Kentucky blue grass has been and is a rather difficult one. Workers and writers who have undertaken to deal with this subject vary much in their conclusions as to the important factors. One investigator[a] who has made a considerable number of experiments says that light is detrimental;

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[a] Nobbe.

others [a] who have made, I suppose, equally careful experiments, have come to the opposite conclusion. In one series of tests it was shown that seeds exposed to direct sunlight for a short time each day and to diffused light for the remainder of the day grew well, while those exposed to diffused light all the time did not germinate well. In one case [b] alternating temperatures were compared with constant temperatures and the results seem to show that a constant temperature of about 30° C. is advantageous and that the temperature should not be alternated; others [c] show that if the temperature is alternated between 20° C. and 30° C. the best results will be obtained.

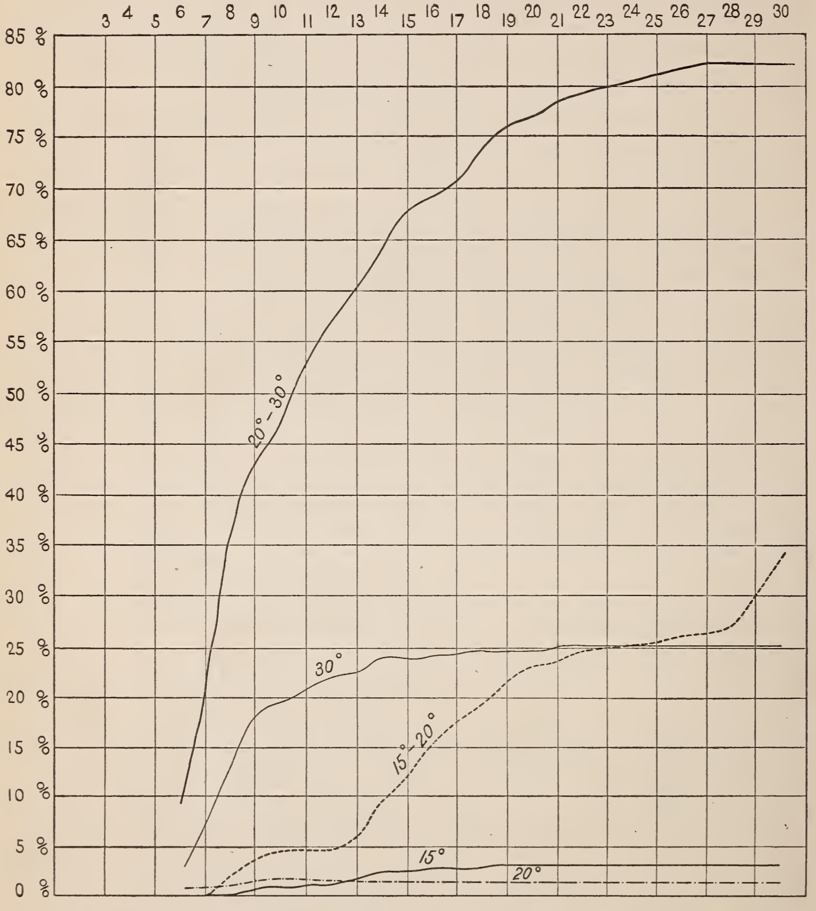

CHART IV.—Showing germination of Kentucky blue grass seed under different conditions of temperature.

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[a] Stebler, Ciesler.

[b] Hartleb.

[c] Burchard, Vanha, Von Liebenberg.

During the last year we have carried on in the Seed Laboratory a series of experiments with these seeds. Two kinds of tests were conducted, one in germinating chambers and the other in sand in the greenhouse. In the chamber tests the seeds were placed between pieces of folded blotting paper which were moistened and laid on trays in the chambers, which were kept at different degrees of temperature, all the other conditions being as nearly identical as possible. One series of tests was made at a constant temperature of 15° C., another at 20° C., another alternating between 15° C. and 20° C., still another alternating between 20° C. and 30° C. In each case the seed was kept at the higher temperature for some five or six hours each day and at the lower temperature for the remainder of the twenty-four hours, the trays being changed from one chamber to another to bring about this alternation. Chart IV shows the germination at the different temperatures, both constant and alternating, the figures at the left hand giving the percentage of germination and those at the top showing the number of days that the test had been in progress. It will be seen that the seed which was kept at a temperature alternating between 20° C. and 30° C. germinated 81.75 per cent, while that kept at other temperatures, either alternating or constant, did not germinate over 33.5 per cent. This shows clearly the advantage of a temperature alternating between 20° C. and 30° C.

As we wanted to get all the different conditions that might affect the germination of seed, three different series of tests were made, keeping the blotters at different degrees of moisture. Chart V shows the germination under the different conditions of moisture, the figures at the left hand showing the percentage of germination and those at the top the different conditions of temperature. The "dry" blotters did not show water when pinched between the thumb and finger; the "moist" blotters showed the water when pinched between the thumb and finger, while the "wet" blotters were kept very nearly at the point of saturation. It will be seen that the matter of moisture had practically nothing to do with the percentage of germination.

The experiments that we made to get the effect of light were conducted in the greenhouse in sand. We first tried the use of a cell filled with a saturated solution of alum to cut off the heat rays and allow the chemical rays to pass through, but this was not successful. We then planted seeds in granite-iron dishes in sand at three different depths—at the surface, one-eighth inch deep, and one-half inch deep. Chart VI shows the results of these tests, the figures at the left giving the percentage of germination and those at the top showing the condition of moisture. The "dry" sand was barely moist, the "moist" sand about as it would be kept in ordinary greenhouse work, and the "wet" sand nearly saturated. It will be seen that all of the seeds which were planted one-half inch deep grew well, while those that were one-eighth inch deep and on the surface did not grow well in the "dry" sand nor as well in the "moist" sand as those sown one-half inch deep.

An experiment was tried to ascertain the depth to which light would penetrate the soil, and it was found that when a piece of ordinary printing out silver paper was covered with a layer of fine sand one-sixteenth inch thick it could be exposed to direct sunlight for several hours without discoloring, showing that this thickness of sand cut off the chemical rays. As the seed which was planted deep in the sand grew better than that which was more shallow or on the surface, even when there was an abundance of moisture, and the seed in the germinating chambers which were subjected to a temperature alternating between 20° C. and 30° C. grew equally well, it seems that the matter of temperature is the important one, and that light, or the chemical rays at least, have no effect. In the tests mentioned above, where an advantage was found in placing the seed in direct sunlight for a portion of the day, an alternating temperature was obtained by means of the heat rays, while the short rays had no effect.

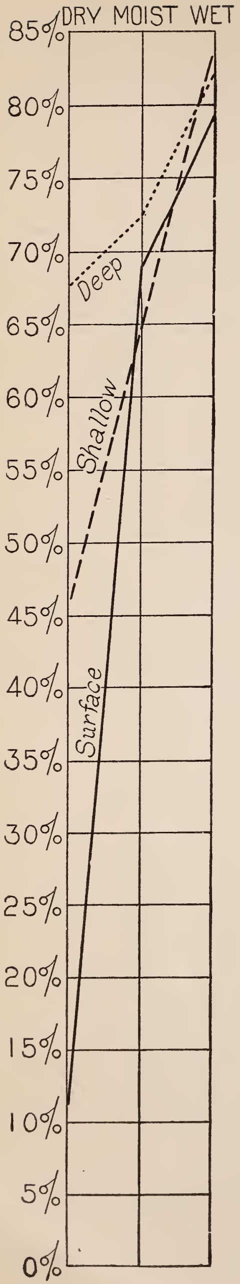

Chart V.—Showing germination of Kentucky blue grass seed under different conditions of moisture.

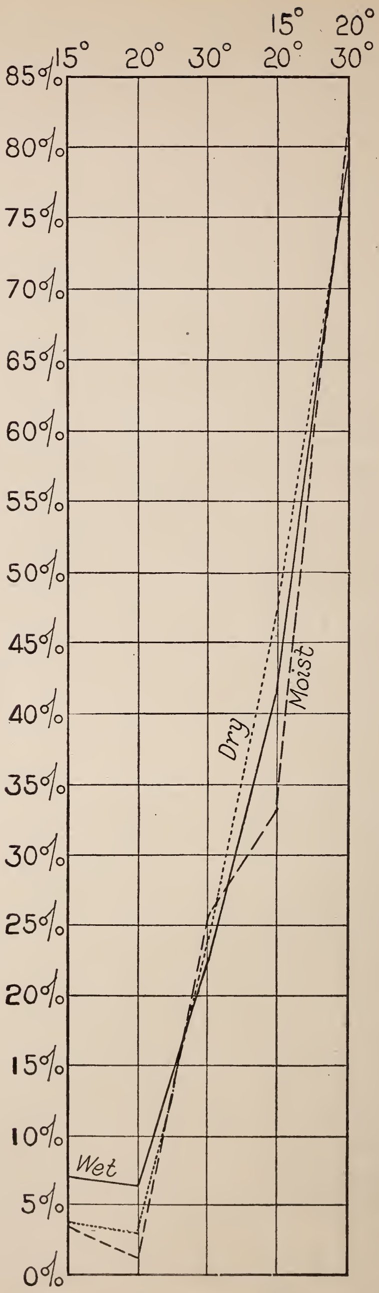

Chart VI.—Showing germination of Kentucky blue grass seed at different depths in sand.

In order to ascertain the temperature of the upper stratum of the soil, observations were made with thermometers at different depths, the thermometers being read every 15 minutes. Chart VII shows the results of observations made on October 25, 1900, from 6 a. m. to 12 p. m., the observations being taken at one-fourth inch and 2 inches from the surface. It will be noticed that the soil at one-fourth inch from the surface varied from 13° C. at 6 o'clock to 29° C. at 1.15 o'clock, or 14¼° C. in 7¼ hours, while soil at 2 inches varied from 15° C. at 6 a. m. to 24° C. at 2.30 p. m., or 9° C. in 8½ hours. Chart VIII shows the temperature of the soil at the same depths, and also the temperature of the air on May 24, 1901.

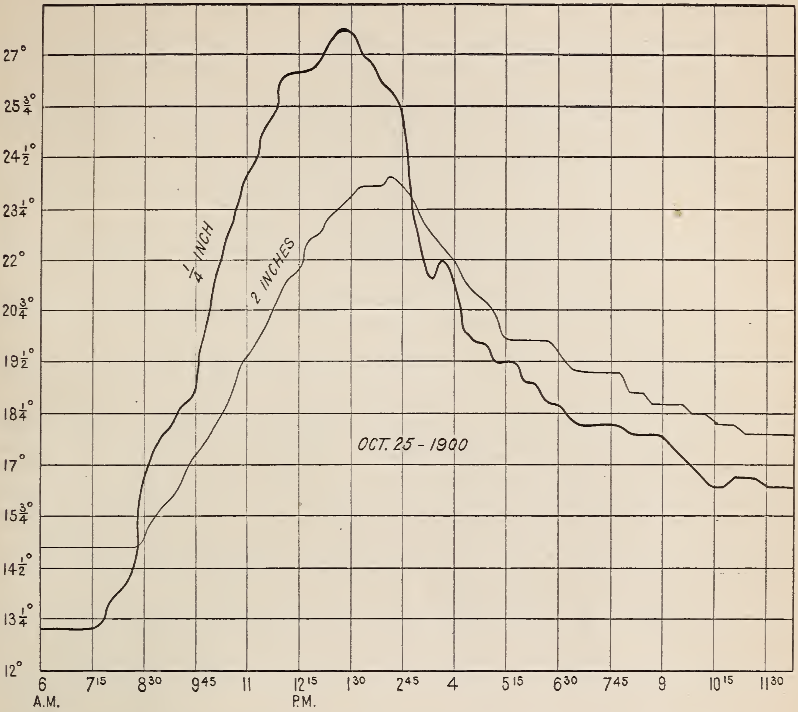

CHART VII.—Soil temperatures one-fourth inch and 2 inches deep, taken October 25, 1900.

It will be seen from these charts that the upper layers of the soil pass through very rapid alternations of temperature, thus affording the conditions which have been found necessary to induce the artificial germination of seeds like Kentucky blue grass. In different kinds of weather a great variety of combinations of temperatures will be found, both those that are nearly constant and those having wide alternations. In the early spring, while the ground is still wet and cold, the alternations will be very much less marked than later in the year, and such seeds as lettuce and clover, that usually start very early in the season, do better under low and constant temperature than when subjected to a high or widely alternating temperature. The seeds of some of the tropical and subtropical plants, such as teosinte, which will only germinate artificially at a high temperature, will not grow in the open ground until late in the season. Each kind of seed requires a certain condition of temperature under which it will germinate readily, and the question of moisture seems to be a minor one, providing there is a sufficient amount present to allow the seed to swell. Light, aside from the heat rays, seems to have no effect.

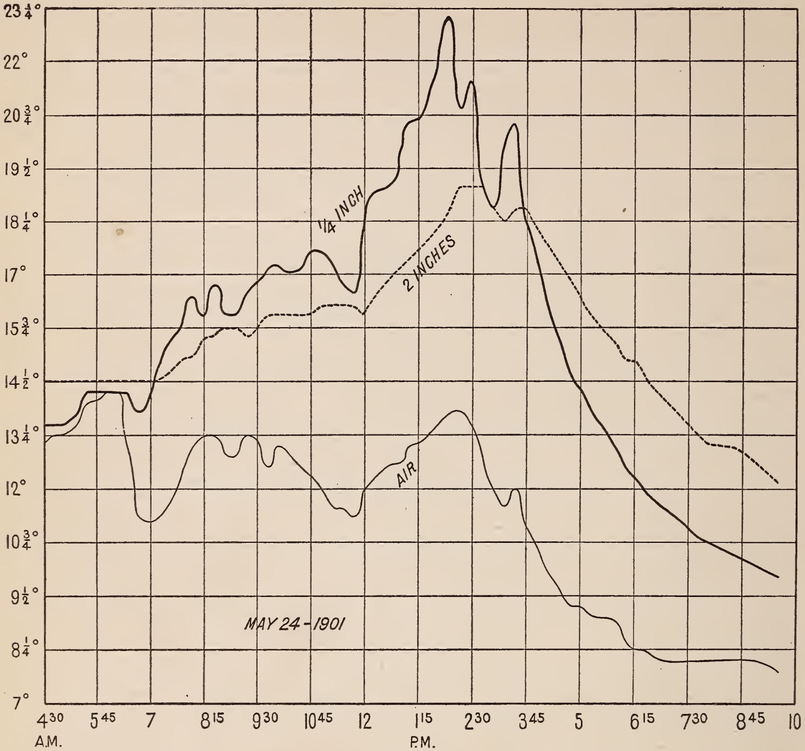

Chart VIII.—Soil temperatures one-fourth inch and 2 inches deep and the air temperatures, taken May 24, 1901.

The Seed Laboratory intends to take up the seeds of the various grasses and forage plants, as well as vegetables, and treat them in a way similar to the experiments with Kentucky blue-grass seed outlined above in order to get at the best condition for artificial germination of each.

Arlington Experimental Farm of the U. S. Department of Agriculture.

L. C. Corbett. Mr. Chairman, feeling that perhaps the horticulturists here may be interested in the new experimental farm which has recently come into the hands of the Agricultural Department, I wish to say something about its condition and what we propose to do with it.

This tract of land, comprising about 400 acres, is in front of the Arlington Cemetery—a part of the old Robert E. Lee estate. The cemetery proper is located on what is really the second bank of the river—a very rolling piece of land, while the portion assigned to us as an experimental tract is quite flat—broken only to the extent of perhaps 20 feet difference in elevation over the area of the tract. Until a little more than a year ago this tract was a common or pasture. The proverbial Government mule had wandered over it at will for a good many years and had taken very little from it, so that we find it in a very good state of fertility. I was greatly surprised to find the land in as good a condition as it is. But of course there has been a great deal of feeding there, and the mules have taken practically nothing from the land. So much for the location and contour.

The character of the soil is a clay loam, in general, although some of the ridges are gravelly and some of them are composed of Potomac deposit—which is characteristic of this whole country—small pebble and sand.

The farm is drained by one main ditch, running through almost the center. It is a large open ditch, carrying practically all the water from the cemetery. Tributary to this are several smaller open ditches and a great number of tile drains.

The treatment I have been giving the land has consisted in breaking it up to a depth of about 10 inches and planting green manuring crops. Our object is to get as much humus into the soil as possible.

The first and perhaps most important use to which we propose to devote this tract is to raise there an extensive variety of fruits—to make it a place where all people interested in the study of varieties of fruits may go and see them growing in fairly good condition, so far as we can obtain such condition.

We hope also to carry on cultural experiments, which will doubtless be supplemented by a study of fertilizer requirements of fruits and plants. These field observations on the food requirements of plants may be supplemented by laboratory work.

I hope we shall be able to give especial attention to the work of testing varieties. The variety test work which has been carried on along horticultural lines has been very unsatisfactory. It has had only a local bearing and has been of benefit to only a very limited area. For instance, in West Virginia, where I was located, the result of a variety test carried on at the station would have practically no bearing on other sections of the State, because of differences in the soil and climatic conditions and the elevation. If cooperative variety tests could be carried on along certain definite lines—if certain observations were made for each plant—the results when arrived at might be compared, and valuable data as to the influence of climate and soil conditions on plants might be obtained. I hope horticulturists will give their attention to this problem, so that our variety tests may have more than a mere local bearing. Variety tests are very important, but if they are to have only a local bearing it is scarcely worth our while to spend time on them. We want information upon a general problem, such as the influence of soil and climate on the growth of the plant.

I hope we may also be able to form an alliance with the seed growers, so that, if possible, the Department may come into possession of new varieties to introduce to the public. It often happens that these seedsmen introduce practically the same thing under different names. If these new varieties of seeds could be brought together and tested at some central point, under like conditions, before they are introduced to the public, then, instead of having two or three different seedsmen introducing the same thing under different names, these seeds could be introduced simultaneously under the same name. Thus we could get rid of a difficulty which now exists.

I would be glad if horticulturists would aid us in carrying on cooperative work in horticulture in order to get more information primarily upon the influence of climate upon plants. It is desirable that this should be done through the Bureau of Plant Industry. We hope to be in such a position that when a cooperative experiment of this kind is in progress we may be able to detail some individual to have general supervision of the experiment so as to avoid the necessity of bothering a number of persons with the same class of work. For instance, when we are carrying on a line of fertilizer work in half a dozen different States, it would be desirable, instead of having a horticulturist in each State to be responsible for local work, to have some general supervising official who would designate some man to look after details, the results being brought back finally to one central point.

C. B. Waldron, of North Dakota. In the Northwest our greatest trial in the cultivation of apples is the ordinary blight. It has been suggested, of course, to every horticulturist that there might be some condition of soil or some particular method of culture that would so influence the particular variety that it would not be so susceptible to blight. As we are located, study of this question is rather difficult. In Fargo, for instance, our soil is absolutely uniform in physical texture and chemical make-up. We have no substations, and thus it is practically impossible to cultivate trees under different conditions. If we could have the cooperation of the Department in growing apples under various conditions, and microscopic studies of the twigs of the plant to find out just what kind of growth is needed to enable the trees to resist the blight when it comes in a serious form, such a thing would be most desirable and important.

It is possible there are certain kinds of soil and certain methods of culture which in the Northwest might insure to us more or less freedom from this blight. If such a result could be obtained we would be able to cultivate apples successfully, because we have varieties of apples which are hardy enough to endure our winters.

J. Craig. Mr. Chairman, I wish to express my personal interest in the development of this Bureau of Plant Industry; and now that we have something, as outlined by Professor Corbett, that touches the horticulturists and the botanists somewhat closely, we hope to be intimately connected with the work. It seems to me that the general scope of the enterprise as outlined is one which ought to do a great deal toward coordinating the work of the horticulturists of the experminent stations in different States. It seems to me that this is just the kind of work that ought to be done. We need to pick up facts here and there, to compare them, and from them deduce principles which are to be of value. I am extremely interested in the line of work which Professor Corbett has placed before us, and I am very glad to know that we may expect a cooperative hand from this central authority, the Department of Agriculture.

F. W. Rane, of New Hampshire. Mr. Chairman, it seems to me that Professor Corbett has touched on the probable solution of the problem that we have to meet—the question of variety testing in horticultural work. We have been in the habit of thinking that this kind of work is of little importance. On the contrary, it is of great importance to practical men; and as I endeavored to bring out in a paper which I read last year to this Association,[a] if we desire to succeed in variety testing, we must pay more attention to it than we have paid in the past. At present one station goes into variety testing quite extensively, while another pays comparatively little attention to it. I feel that the stations which are doing a considerable amount of this sort of work are getting in touch with practical men in their States. I believe thoroughly that this variety-testing work can be made highly useful. I believe that we have at present the nucleus from which perhaps we may work out this problem.

J. S. Newman. In 1868 I had in middle Georgia an orchard of 20 acres embracing 45 varieties of apples. At that time the twig blight appeared on but one variety, known there as the Buncombe apple; and it appeared on that only on the bloom buds. On this particular variety the blight appeared every year, while the other varieties were altogether free from it. For eight years this twig blight appeared on the Buncombe apple and did not appear on any other. At the present time I do not know that there are any varieties of apples that are free from the blight. From a limited beginning it has progressed until now it is almost a universal trouble. There are some localities which are free from it, but as a rule it attacks every locality and every variety.

I do not think the soil conditions in this particular orchard had anything to do with the trouble. I attributed it at first to the late blooming of the variety affected.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 99, p. 141.

Possibly the period of blooming might have been hastened by planting in a different soil, but the conspicuous fact was that that variety alone was attacked in the first instance by this blight and now the blight is universal.

COMMITTEE ON NOMINATION OF SECTION OFFICERS.

The chairman announced the appointment of the following as the committee for nominating section officers: J. Craig, of New York; W. A. Taylor, of the Division of Pomology in the Department of Agriculture; and A. Nelson, of Wyoming.

This committee later reported as follows: For chairman, J. Craig, of New York; secretary, A. Nelson, of Wyoming.

The report was accepted, and the nominees were confirmed in general session. (See p. 63.)

PORTO RICAN FRUITS.

F. D. Gardner exhibited, with various comments, samples of fruits recently brought by him from Porto Rico, where he has charge of the experiment station established under the auspices of the United States Department of Agriculture.

ROOT KNOT OF THE COWPEA.

H. J. WEBBER, of the U. S. Department of Agriculture. Mr. Chairman and gentlemen, probably you are all familiar with the famous cowpea, which is really the clover of the Southern States. Without it I do not know what the Southern farmers would do in renovating their soil. Probably there is no renovating crop in the South, north of Florida, that can take the place of the cowpea, especially in peach orchards and following or preceding cotton.

Unfortunately the cowpea is subject to several rather serious diseases. One of the most serious of these is the root-knot worm of the South, which, as you probably know, attacks a great variety of plants—cotton, tomatoes, cabbages, and many others. The methods of treatment which have been proposed are all very unsatisfactory. This worm makes its way through the soil to the roots, and for this reason it is almost impossible to reach such a disease with any fungicide or insecticide which we can apply. A great many fertilizer tests have been made with a view to controlling the disease. So far as we can harden the roots by this means we are likely to lessen the damage caused by the worm. Again, the soil may be burned out with quicklime. But thus far, if I am correctly informed, no chemical fertilization has proved very effective in treating this malady.

One of the most common of the attempted remedies is the sterilization of the soil; that is, the cultivation, on the land infested, of some plant that is capable of resisting this worm, and continuing this cultivation until the worms have been destroyed. But of course the effects of this sterilization last for only a short time. The disease soon appears again, because it is so prevalent all over the country and attacks so many plants that it is easily introduced again.

Another method which has been practiced a good deal is the planting of so-called trap crops—i. e., crops that are very susceptible to attack—and later digging them up and destroying them, thus killing large numbers of the worms. But this method is very costly and rather unsatisfactory.

It is therefore with considerable pleasure that I am able to tell you that we have found a variety of this plant that appears to be resistant to the disease. In the course of experiments with a number of cowpeas and various other plants it was found that one variety of the cowpea had shown the power of resistance to the disease. This is the so-called "little iron" cowpea—a variety which has recently come into prominence. An examination of hundreds of plants of this variety showed hardly any indication of the action of the root-knot worm, while the plants of several other varieties in the same field were all seriously affected. I believe we can say that we have one variety that we can plant almost with impunity upon any soil that may have been affected by this worm.

Now, it is notorious among growers in the South that land becomes pea sick; the soil becomes exhausted in some way, so that it is impossible to grow cowpeas with any degree of success. I suspect that if we examined into the matter carefully we would find this condition of the land due to some of these diseases. Cotton is badly affected with this disease. I am told that some growers have observed that on fields where cotton follows cowpeas the disease is worse than usual. And it has been a common remark among peach growers of the South that cowpeas in a peach orchard cause the development of this worm. If that observation is correct, we have here a pea which can be cultivated in peach orchards with impunity without danger of conveying this disease to the peaches.

However, I think that the greatest value of such observations as these lies in our being able to point out a way in which we can treat a disease of this kind. If it is possible for us to find species of cowpeas so nearly related as these, one being a resistant of this worm and the other badly affected, it would seem possible to collect two species of peaches, one of which may be a resistant, while the other is ordinarily affected. One of the most promising lines of this experimentation in treating peach diseases is simply to examine large numbers of nursery trees and see whether it is not possible to select a resistant stock on which we can bud other varieties; and the same thing might be done with other crops. I think there may be a very considerable future for investigation in this direction.

Mr. Webber stated in reply to a question that, as far as he knew, the disease extended only to about the line of southern Virginia and running across the country, but that its limits had not been definitely fixed.[a]

W. J. Spillman, of Washington. We have made quite a number of preliminary observations at our station along this line, and I wish to speak of one in particular. A year ago last spring the potato blight prevailed quite seriously in western Washington. It was observed that several varieties resisted the blight very materially—were hardly affected by it; and those were saved for seed. Unfortunately for our experiment, there was no blight this year, so that we do not know whether we have gained anything by saving those particular potatoes for seed. I think it entirely possible for us to breed resistant varieties. In the country where I live—a great wheat-growing country—we are trying very hard to find wheat adapted to the conditions. We are endeavoring by selection—and I believe this is a point of very much more importance than has hitherto been recognized—to find a variety of wheat which will not be liable to smut. I hope that the horticulturist and the botanist of the country will join with the agriculturist, so that in time we may breed a large number of varieties that will resist both insect and fungus diseases.

M. A. Carleton, of the U. S. Department of Agriculture. In this connection I would like to mention a case which I think will be of considerable interest to both the botanists and the horticulturists. There is in this city a species or variety of the cottonwood sometimes called the South Carolina poplar. Now, there is a rust disease on the common cottonwood of the West which is familiar to everyone. It is a very striking fact that absolutely no rust occurs, so far as my experience goes, on this South Carolina poplar here, while the rust is very common wherever the ordinary cottonwood is found. There are a few of the cottonwood trees in Washington, and when the rust is prevalent you may find it on these trees, but never on the South Carolina poplar.

In regard to the breeding of plants that may be resistant to disease, it must be remembered that a plant may be resistant to one kind of fungus and not to another. I have spent five or six years in the study of rust disease in wheat, and I have found a number of varieties that are quite resistant to ordinary wheat rust, but not at all resistant to the other rusts. It is to be remembered that if you breed a plant so that it has more resistance than before, it may, after a while, again gradually become subject to attack by this disease.

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[a] For a fuller account of the study of this disease see U. S. Dept. Agr., Bureau of Plant Industry Bul. 17, p. 23.

If you take one of the highly bred wheats of the Northwest and grow it in Colorado, for instance, it becomes a quite different wheat; it becomes starchy and white, and there is likely to be a change in the power of resistance to disease.

In many cases there is evidently a difference in the anatomy of the plant, making the disease prefer one plant to another; and I have not a doubt, although the point has not been proven by experiment, that in many cases there is also a physiological condition of the plant which has an effect in either making the plant subject to the attacks of the disease or making it capable of resisting attacks.

We know that a certain kind of rust will play havoc with certain varieties of oats that have a rather soft texture throughout, and that another kind of rust will not affect it at all.

State Aid for Agricultural Experiments.

L. C. Corbett offered, and the section adopted, the resolution on this subject noted on p. 56.

E. Brown, seed laboratory, U. S. Department of Agriculture. Perhaps I ought to apologize to the section for taking any more of its time in talking about seeds; but I think we can perhaps show by reference to some samples the real work of the seed laboratory, what its importance is, and what it means to the farmer.

The question of ordinary vegetable seeds is, as you know, one very largely of variety and can not be determined by laboratory tests; but must be determined by field tests during the summer. But as regards grass and clover seeds it is almost entirely a question of purity; that is, a question of the amount of good seed and the amount of poor seed that a sample contains; and this can be very easily determined by simple analysis in the laboratory.

Except in the case of deliberate adulterations, the selling of cheap grades of seeds, even though containing impurities, can not be charged exactly to the dishonesty of the seedsmen, because he is only supplying the demand for those seeds. When the people demand this grade of seeds, the seedsmen will, of course, supply them. The great trouble is that the purchaser does not realize that in buying low-grade seed he is paying two or three times as much for the seed that will grow as he would pay for the same amount of good seed in buying the best grade; and, besides, he is filling his land with foul stuff that it will take years to eradicate.

In the exhibit of the seed laboratory at the Pan-American Exposition were shown a series of samples of commercial grass and clover seeds purchased in the open market. (Tubes containing samples taken from the same lots of seeds showing the difference in appearance of the various grades were exhibited to the section.) In the following table will be found the results of the purity and germination tests, together with the cost.

Results of purity and germination tests of seeds.

1.	2.	3.	4.	5.	6.	7.	8.	9.
No.	Kind of seed.	Seed bought in the open market, price per 100 pounds.	Inert matter, per cent by weight.	Spurious seeds, per cent by weight.	Pure seed, per cent by weight.	Germination of pure seed, per cent.	Good seed, viz, pure seed that will grow, per cent by weight.	Actual cost per 100 pounds of good seed.
1	Red clover	$10.50	1.2	0.3	98.5	98	96.53	$10.88
2	.....do	10.00	6	3	91	86.5	78.91	12.70
3	.....do	9.25	6	47	47	99	46.53	19.81
4	.....do	5.50	39	21	40	61	24.4	22.45
5	Redtop	9.50	9	.5	90.5	80	72.4	13.10
6	.....do	6.00	45	1.5	53.5	85	45.47	13.19
7	.....do	2.50	74	3	23	62.5	14.37	17.24
8	Beardless brome grass	17.00	7	4.5	88.5	91.5	78.97	20.98
9	.....do	25.00	34.5	5	60.5	50.5	31.05	71.43
10	.....do	20.00	38	13.5	48.5	78	37.93	52.63
11	Kentucky blue grass	8.00	9.9	.1	90	86	77.4	10.32
12	.....do	7.00	19.5	.5	80	75	60	11.66
13	.....do	7.00	18.5	36	45.5	80	36.40	19.18
14	.....do	4.00	91	1	8	55	4.4	88.88
15	Orchard grass	9.00	15.5	3	81.5	86.25	70.29	12.81
16	.....do	7.00	37.5	24	38.5	79.5	30.60	22.95
17	.....do	5.00	73.5	10	16.5	79	13.60	38.46

The third column of the above table gives the price at which the seed was sold; the fourth, fifth, and sixth columns give the result of the purity test; the seventh, the result of the germination test made from the pure seed. The eighth column gives the amount of good seed—that is, the amount of pure seed that will grow and is of actual value. The ninth column gives the price actually paid per 100 pounds for the good seed shown in column 8 when buying the original sample at the market price shown in column 3.

RED CLOVER.

The four samples of red clover were purchased from different seedsmen.

No. 1 is a very fine sample.

No. 2 is a good average sample.

No. 3 is an adulterated sample, containing 47 per cent of weed seed, 42½ per cent of which is trefoil or black medic. This is the most frequent adulterant of red clover, and one not easy to distinguish from red-clover seed.

No. 4 is a very low grade sample, containing 39 per cent of dirt and 21 per cent of weed seeds of all kinds. This grade is frequently sowed through the South when the crop is to be plowed under for green manure.

A comparison of the prices in columns 3 and 9 shows the economy in buying the best grade of seed.

REDTOP.

The three samples of redtop were purchased of one firm and represent the grades which they were offering at the time.

No. 5 is a good sample of "fancy" seed.

No. 6 is a rather poor sample of "fancy" seed, as it contained a large percentage of chaff.

No. 7 is a sample of "chaff" seed. While the percentage of weed seed seems rather low, only 3 per cent, still about one-eighth of the seed in the sample is weed seed, while in No. 6 about one thirty-seventh of the seed is weed seed and in No. 5

only one one-hundred-and-eightieth is weed seed. Aside from the large proportion of weed seed and the higher actual cost of the good seed in No. 7, the seed that it contains is lighter than that in the better grades, and consequently will not give as vigorous plants in the field.

BEARDLESS BROME GRASS.

These three samples were purchased from different seedsmen.

No. 8 is a better sample than is usually found on the market and it was sold at a lower price than either of the other two. While No. 9 is much better than No. 10, the original price was so much higher that it makes the cost of the good seed very much more than that of either of the others. No. 10 contained a considerable amount of chess, or cheat. A comparison of the prices in columns 3 and 9 show that the price asked for seed can not safely be relied on as indicating the quality of the seed when it is purchased from different seedsmen. This is especially true in the case of such seeds as beardless brome grass, which has only recently come on the market.

KENTUCKY BLUE GRASS.

The four samples were purchased from different seedsmen.

No. 11 is a good grade of "fancy" seed.

No. 12 is a fair grade of "fancy" seed.

No. 13 is a sample adulterated with 31 per cent of Canada bluegrass.

This is the most dangerous and common adulteration of Kentucky blue grass and one very difficult to detect.

No. 14 is a sample of "chaff" seed, and contains so small a per cent of good seed that it is worthless.

ORCHARD GRASS.

The three samples of orchard grass were purchased from the same firm as the redtop.

No. 15 is a very good grade.

No. 16 contains 10½ per cent of English rye-grass seed, which is much cheaper than orchard-grass seed and is too often used as an adulterant.

No. 17 is a very low-grade sample.

A comparison of the prices in columns 3 and 9 again shows the economy in buying the best grade of seed obtainable.

The seed laboratory is making tests both for purity and germination of samples that are sent in by persons purchasing seeds. Any farmer can avoid the possibility of sowing poor seed by simply taking the trouble to get samples and send them to be tested. There is no charge made for seed testing.

After remarks by Messrs Green, Corbett, Clark, Jordan, and Craig in regard to preparation of the next programme, the section, on motion, adjourned *sine die.*

SECTION ON ENTOMOLOGY.

The Section on Entomology met during the afternoons of November 11 and 12, Chairman Slingerland presiding. In the absence of Secretary Morgan, H. E. Summers was elected secretary pro tempore.

Some twenty delegates were present at the sessions.

The chairman made a brief oral report on the proposed change in the constitution of the general association which would eliminate the entomological section, stating that in answer to questions from the secretary of the section regarding the advisability of this action addressed to the entomologists of the stations, about twenty answers were practically unanimous in objecting to the change. In his report to the general association he had made a plea for the continuance of the section.

The reading of papers was then taken up, J. B. Smith, of New Jersey, presenting the following paper:

A Year's Experience with Crude Petroleum.

The winter of 1900–1901 was the third during which crude petroleum has been used in New Jersey, and the second during which it has been generally used. As our fruit growers have become better acquainted with it, its use has been extended, and in the winter last passed nearly 500 barrels have been applied. This means between 20,000 and 25,000 gallons and the treatment of between 250,000 and 300,000 trees, large and small.

It will be conceded, I think, that this is no longer a mere laboratory experiment or an inconclusive trial on a few carefully handled trees. Some few of the men used fully 1,000 gallons each, while the other was used by all sorts and conditions of farmers and fruit growers. Much of it was applied undiluted, and at least an equal proportion was put on with some sort of emulsion pump—usually the Gould "Kero-water"—in a 20–25 per cent mechanical mixture with water.

As to the character of the trees treated, they included all the ordinary orchard fruits save cherry.

Whatever danger and harm is in the oil should have made itself evident in great numbers of dead and dying trees and loud complaints on the part of the orchardist. Some injury has been caused, undoubtedly, and a few trees have been killed; but the injury was small in comparison to the number of trees treated, and much of this was due as much to the condition of the tree itself as to the oil. Trees at the point of death from scale are not fair subjects for insecticide materials.

In the southern part of the State undiluted oil was most generally used, while in the more northern sections the 25 per cent mixture was the favorite.

One of the south Jersey growers who used 1,000 gallons of oil applied undiluted in January and February on apple, pear, and peach reports not a single tree injured. The trees treated the previous year required no treatment, the oil having so reduced the number of insects and protected the bark so far along in the season that not until late in summer did the scale succeed in regaining a foothold.

Taking up the various fruits, the oil has been most effective and almost if not quite harmless on pear. This has a smooth bark, except on the trunk of old trees. It wets easily and does not hold or absorb much. So not only is the scale readily reached, but the tree is saved from injury. As the question has been asked, what would be the effect of treatments made in consecutive seasons; it may be of interest to state that the Duchess dwarf pear, which formed the subject of the first experiment in January, 1898, has been treated at least once every year since and is yet one of the most vigorous trees in the orchard, having almost outgrown its dwarfed character.

Apple, curiously enough, is quite sensitive to the oil, at least in certain varieties. Ben Davis seems to be most readily injured, and quite a number of this variety have been badly hurt and a few killed. On the other hand, some others seem to stand any amount of oil. A Grimes Golden Pippin in the experiment orchard became very badly infested with scale late last fall (1900) and went into the winter absolutely coated. In January I treated this with a brush by simply letting the oil run down from the tips of the twigs to the branches, then from the branches to the trunk, and from the trunk to the ground. In other words, the tree had just as much oil as would remain on it, and in the latter part of January I felt satisfied that I had done the trick and killed the tree. But it came out all right in the spring of 1901, a little delayed and with a few dead twigs, but otherwise in good shape. It held its foliage almost completely in November, after every other tree was practically bare. As to scales, there are no living examples, except on one shoot, which I must have missed. On the trunk and some of the larger branches the outer bark is scaling off, leaving a smooth, healthy tissue below it.

As to plums, these resist the oil perfectly. One large orchard in south Jersey was treated with undiluted oil in the winter of 1900–1901, but scantily from fear of causing injury. A few trees were fully treated, experimentally. The scale was kept down and a full crop was secured. As the experiment trees showed no signs of injury, this orchard will be thoroughly treated the coming winter, the owner reaching this decision on the basis of his own experiments.

Peach is the most sensitive subject, and most of the injury that has been caused has been on this fruit. There seems to be a real difference between localities as well as varieties in susceptibility to injury from crude oil. I have always used it undiluted with entire safety, and so have most of my south Jersey correspondents. But with some it has caused injury and has even killed trees. In the northern counties the undiluted oil has been looked on with suspicion and few have used it. It has proved safe enough when properly used; but the tendency has been rather to over-caution, and the results have not been what they should have been. The 25 per cent mixture confidently used has given better satisfaction, and this will, I think, come to be the combination used there.

I still adhere to my formerly expressed belief that the undiluted application is preferable, if properly made; but perhaps in view of the experiences reported, the 20–25 per cent mixture is, in ordinary hands, the safer. At all events, the year's experience with crude oil has resulted beneficially on the whole and our orchardists will use more than ever, with greater confidence, due to personal experience.

In view of the reports received from some southern localities, it is proper to say that my results were all obtained in New Jersey, and these may not hold under other climatic conditions.

In reply to a question, Professor Smith stated that the price of crude oil was last year 8 to 9 cents per gallon, but had shown a rising tendency, being now 11 to 12 cents.

W. M. Scott, of Georgia, stated that he had used considerable crude oil in that State and was able to obtain it in car lots at 8½ cents, so that it could be delivered at the orchard in 250-gallon lots at 12 cents.

J. Troop, of Indiana, had obtained oil of the local wells at 2 cents. This is a very heavy oil, however (34° Baumé), and was therefore difficult to spray. It had been used mostly on pears, and no injury had been noticed. Mr. Smith regarded the heavy oil as better when used in mixture.

W. G. Johnson called attention to the fact that even when spraying was not carried on there seemed to be a tendency to the disappearance of the scale in many localities. In one case he had noticed 9,000 9-year-old peach trees that had been thoroughly infested, but the scale disappeared without known cause. No fungus could be found. In neighboring orchards the scale remained abundant. He had noticed several other cases both near tide water and in the mountains. Messrs. Smith, Alwood, and Scott had noticed the same thing in their respective States, but could give no explanation.

Mr. Scott stated that in Georgia peach trees suffered little after they were 7, or even 6, years of age. He does not find treatment necessary when the scale gains entrance to an orchard that is 6 or more years old.

Professor Smith noted a case that indicated that the variety affected had considerable influence on the rate of progress of the disease.

H. T. Fernald, of Massachusetts, called attention to the fact that it was difficult without extremely careful examination to always detect the presence of the fungi. He had found them present in perhaps one out of fifty of the living scales examined.

Professor Fernald read the following paper:

Insects of the Year in Massachusetts.

The year 1901 has not been marked by the devastations of any one insect, but several well-known forms have been the cause of quite an amount of damage to various crops. During 1900 the birch bucculatrix was very abundant in the southern half of the State; the past summer it appeared in large numbers in the northern portion, while the southern part appeared to be but little affected. Plant lice have been quite abundant and have seriously affected a number of crops, but with these exceptions the only insects worthy of mention are the elm-leaf beetle, the gypsy moth, the brown-tail moth, and the San José scale.

The elm-leaf beetle has been present in the Connecticut Valley for seven or eight years, but has made its presence felt to but a slight degree in the eastern portion of the State until the past summer. During June, July, and August of the present year, however, it has been much in evidence over the entire eastern part of Massachusetts, stripping the elms and causing much fear lest these trees so much relied upon as ornaments to our streets and in residential districts might be destroyed. This fear has led to much correspondence, many experiments, and a great waste of time and money by the use of methods of treatment worthless or nearly so, by those who felt confident that their training gave them the necessary information with which to cope with insect foes.

When the work of the State against the gypsy month ended in the spring of 1900, this pest was well under control, and had been exterminated in most of the outlying districts, though it was still abundant in some of the towns near the center of the infested area, the aim of the commission having been to work inward from the periphery. Two seasons have now elapsed since this work ceased. At the present time the insect is very abundant in those towns where the work of extermination had been least carried on and it has also spread, so that most of the area once freed from it is now reinfested. Any attempt to resume the work hereafter should be made with the clear understanding that the gypsy moth is now about as generally distributed as it was in 1896, although probably over most of the infested area it is less abundant than it was at that time.

The appearance of a colony of this insect at Providence, R. I., would be of interest in this connection were not its presence there generally believed to be more than merely accidental.

The brown-tail moth has spread rapidly and is now generally distributed north of Scituate and east of Hudson. It is present in lower New Hampshire and in the southwest corner of Maine. In Massachusetts it is probably present over more than 1,500 square miles, and where it is abundant has caused much inconvenience to the residents, as the hairs of the caterpillars cause a severe irritation when they touch the skin, often necessitating the services of a physician. From the standpoint of its destruction to crops, this insect is fortunately less to be dreaded than the gypsy moth, and the habit it has of passing the winter in tents made at the ends of the twigs and containing several hundred larvæ together renders its destruction at this time easy.

The San José scale in Massachusetts, as everywhere, is a most serious pest. It is now known to be present in 52 different towns, and is not unlikely to be present in five times as many more. It appears to be most destructive to apples, pears, plums, currants, and certain ornamental shrubs and trees, such as *Prunus pissardi*, while the peach has thus far seldom appeared among samples of infested plants received. It is present in nurseries, orchards, residential grounds, and, in one or two cases at least, is generally distributed over areas of several square miles, where it is present on most of the deciduous trees and shrubs. It is present in such abundance in some cases that apples, pears, and even currants have been so thoroughly covered by the scales as to prevent their sale. As there are no laws controlling the introduction of nursery stock into, nor requiring inspection of nurseries within, the State, and as it is probable that the majority of the nurseries are infested, it is presumably but a matter of a few years when the San José scale will be present in destructive abundance in nearly every town in Massachusetts.

In reply to inquiries from Messrs. Wilcox, Howard, and Smith, Professor Fernald stated that the gypsy moth had not yet spread beyond its old limits, but is rapidly refilling this district, from a large part of which it had been almost exterminated. No other colonies than the one at Providence are now outside of the original district. They are doing practically nothing toward its extermination in Providence.

M. V. Slingerland, of New York, presented the following paper:

Some Suggestions and Notes.

If the proposed change in the constitution of this Association, by which the entomological section will be practically eliminated, is not made, I would suggest that an effort be made to confine the programmes for future meetings of the section to one or two definite topics relating to important methods or phases of station and college work. Then our discussions will not conflict with those of the strong Association of Economic Entomologists. Perhaps a simple method would be to appoint a committee to consider and specify certain topics to be discussed at the next meeting. Many entomologists who do not now prepare papers would give us their written opinion about stated topics, and such discussions would be very valuable. Last year's meeting of the section, where nursery inspection was the chief topic discussed, was one of the most successful ever held.

The popular names of injurious insects have always been a fertile source for discussion whenever they have been presented to entomologists. Unanimity of opinion rarely results, but it is a question which deserves more thought than it often gets. The popular names of several of our standard pests are admittedly inappropriate, and yet it is a very difficult matter to introduce any change. An example of this was my suggestion to call *Clisiocampa disstria* the "forest tentless caterpillar," since it makes no true tent or silken covering. Some liked the change, but others, in answer to my circular letter, suggested the following names: Forest caterpillar, hairy forest caterpillar, forest worm, forest web-worm, destructive forest caterpillar, wandering forest caterpillar, forest-tree army worm, forest army worm, maple army worm, maple worm, maple forest caterpillar, the maple ravager, forest lackey moth, the tramp caterpillar, the forest clisiocampa, and disstria caterpillar. It is doubtful if any of these, or Dr. Howard's name, the army worm of the forest, will ever supersede the old one of forest tent caterpillar. And when we understand that the generic name, *Clisiocampa*, means *tent-caterpillar* (it should always be written with a hyphen), the name is not so bad. Furthermore, the suggested changing of the name has served to strongly emphasize the almost forgotten fact that it makes no true tent, so that the word "tent" in the popular name has already largely lost its significance.

Photography is now much used to illustrate insect subjects. Dr. Howard's Insect Book is a remarkable example. At least half the value of his photo reproductions is due to the care with which the 1,100 different specimens were spread and set. A half hour thus spent would have raised some of the half-tone pictures that have appeared in station bulletins from a mere blotch of printers' ink to the dignity of a recognizable picture of the insect. A poor drawing is usually better than the best photo reproduction of a mutilated or poorly set specimen. But sometimes the State printer will turn out a very poor picture from the best of photographs. Photography often affords an easy, accurate, and remarkably effective method of illustrating insects, especially their habits and ravages; but let us use it at its best.

INSECT RAVAGES IN NEW YORK IN 1901.

During the past season the ravages of the squash stink-bug, the striped cucumber beetle, and the Hessian fly have been unprecedented in New York. One grower of early cucumbers in hotbeds lost nearly his whole crop, valued at $500, by the work of the larvæ of the striped cucumber beetle in the stems near the roots; and the beetles were unusually numerous in many melon and cucurbit fields. In many gardens, and even in large fields, the usual fight against the squash stink-bug began early in the season on melon, cucumber, squash, and pumpkin vines; but the old bugs continued to appear in such incredible numbers and over so long a period that in many cases the fight was abandoned and the crops were ruined. Serious reports of the ravages of the old bugs began to reach us about July 1, and complaints with specimens reached us nearly every day from some part of New York until after the middle of August, when we began to receive the first specimens of the nymphs. Enough of the old bugs came from somewhere to necessitate hand picking every day to protect the vines. I doubt if New York melon and cucurbit crops ever suffered so severely from these pests as in 1901. The losses must have amounted to many thousands of dollars.

Thousands of acres of wheat and considerable barley were utterly ruined by the Hessian fly in New York this year, and the total loss, estimated at $3,000,000, is much greater than New York wheat growers ever before experienced from this pest. In consequence the acreage of wheat in New York was considerably reduced this fall. But as the climatic conditions were more nearly normal for the appearance of the fly at the usual time, and as many growers held off sowing until very late and also used the early-sown trap strip of wheat, I do not look for nearly so serious losses from the pest in New York in 1902.

PRAYING MANTIDS IN NEW YORK.

In Bulletin 185, published in 1900 from the Cornell Experiment Station, I announced the discovery in 1899 of the common European praying mantis (*Mantis religiosa*) in New York. This interesting insect is still breeding freely in and near Rochester. Vacant city lots and other fields which are allowed to grow up to grass and weeds are favorite breeding places for the insect. Last spring I paid Rochester school children 1 cent each for about 800 of the mantid egg clusters. Over half of these were sent to different parts of the United States and the rest were distributed at Ithaca. For some unknown reason but very few mantids hatched from these eggs, so that apparently this effort to introduce the insect into other localities has failed. I expect soon another invoice of eggs laid this fall, and will try again. It should not be a difficult matter to establish this curious, beneficial insect in many other places.

Last spring I also placed in favorable situations in Ithaca several of the large egg clusters of the oriental mantid (*Tenodera sinensis*) which were sent me by entomological friends near Philadelphia, where this mammoth mantid has been breeding for four or five years. Nearly all of these egg clusters hatched. I was fortunate enough to see the nymphs hatch from one cluster on June 24. They began emerging about 9 a. m., and for a time they piled out with astonishing rapidity, at least fifty of them in five minutes, and a few stragglers continued to emerge for several hours. The nymphs, looking like pupæ with their legs and antennæ held closely against the body, wriggled out of the eggs and hung suspended about half an inch by a thread from their caudal end. Within five to ten minutes after emerging these pupa-like objects shed off a pellicle or skin, and the active little nymphs scampered about on the egg cluster and surrounding objects. It was a very interesting sight to watch, and I succeeded in getting a fairly good picture of the process, as shown in figure 1. A lot of these cast skins were found still hanging to egg clusters which had hatched outdoors several weeks before. Probably a similar interesting process takes place in the hatching of *Mantis religiosa*, but I have not yet seen it, nor have I found any of the cast skins hanging to the empty egg clusters. The nymphs of the oriental species, even when young, often jump, rather than run, out of the way when touched. By July 10 some of the oriental nymphs were an inch long, having molted twice since they began to eat, and a month later some were in their last nymphal stage. In October I saw several of the adult oriental mantids near the insectary and in shrubbery around my home where I had put out egg clusters in the spring; my kitten was found playing with an adult one morning. This oriental mantid has thus maintained itself at Ithaca from early nymphhood to the adult stage, and doubtless eggs have been laid this fall. It is now only a question of its surviving our New York winters to make it another desirable and strange addition to the insect fauna of New York.

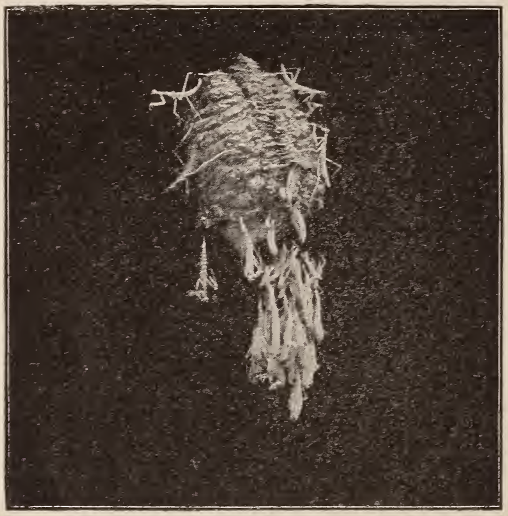

FIG. 1.—Egg cluster of the oriental mantid (*Tenodera sinensis*) from which the nymphs are hatching, natural size.

TWO BUTTERFLIES NOW UNUSUALLY COMMON IN NEW YORK.

The little skipper butterfly (*Hesperia tessellata*) has been noticeably abundant during the past season in the vicinity of Ithaca; and for two years past the giant swallowtail (*Papilio cresphontes*) has been breeding in unusual and increasing numbers in different parts of New York. Many of the "orange dog" or "orange puppy" caterpillars were found feeding on hop-tree shrubs (Ptelea) and on prickly ash at Ithaca this year, and I have received the larvæ from correspondents who found them feeding on lemon and orange trees set outdoors for the summer and on a fraxinella or gas-plant hedge. I have had specimens from the following localities in New York: Ithaca (Tompkins County), Seneca Falls (Seneca County), Waverly (Tioga County), Batavia (Genesee County), Cheviot (Columbia County), and Fallkill (Dutchess County).

On motion of Professor Smith it was resolved that a committee be appointed to prepare a programme for the next meeting, this to consist of an outline of one or more topics for discussion. The chair appointed as such committee J. B. Smith, of New Jersey; W. E. Britton, of Connecticut, and S. A. Forbes, of Illinois. On motion of Professor Smith it was resolved that a committee of two be appointed to nominate officers of the section. The chairman appointed Messrs. Smith and Britton.

A paper on a folding fumigator for orchard fumigation by F. A. Sirrine, of New York, was read by the secretary. The essential features of this paper have since been published in New York State Station Bulletin 209.

C. B. Simpson, of the United States Department of Agriculture, spoke informally on "Codling moth conditions in the extreme Northwest." The full report of the experiments on this insect will be published by the Department of Agriculture.

The following paper was read by E. D. Sanderson, of Delaware:

Aphids of the Apple, Pear, and Quince.

Upon going to Delaware I found the horticulturist of the station interested in the top-working of young apple trees by budding. He had had considerable trouble with aphids clustering upon the young shoots from the buds, and thus killing or stunting them. Of course he merely wished a remedy for the pest, but naturally I was as much or more interested in the life history of the aphids.

Now the apple aphis is well known to all entomologists; at least it has frequently been described in our literature, and I supposed that of course there was practically nothing new to learn concerning it.

Soon, however, I found among the young green aphids some small brown ones, which became large, black, globose females giving birth to some reddish aphids. These were entirely different from anything I could find described in American literature, proving to be *Aphis sorbi* Kalt.

A little later a green form very similar to those most common, but more yellowish, with straight jet-black cornicles was found, which could not be identified. (In my last annual report this was described as *A. padi* Linn., owing to the fact that the first form was then considered *A. mali* Fab.)

Soon after this Dr. Smith's bulletin upon the apple aphis (*Aphis mali* Koch) appeared. Upon comparison of my specimens with his descriptions it was soon evident that our most common form is an entirely different species, but that the last form mentioned above is the true *A. mali* of most European writers.

Dr. Smith very kindly lent me the material upon which his descriptions were based, which I have this season duplicated by collecting, and there can be no doubt of the facts so well set forth in his bulletin.

This aphis is not, however, our most common species, being quite uncommon some seasons, as Dr. Smith also informs me. Our most common species is that described by Fitch, and supposed by him to be identical with the European *A. mali*, but which proves to be entirely distinct. I have secured specimens of the latter from several States, where it occurs commonly and is the recognized *A. mali*, but have received none of the true *A. mali* with them.

It therefore seemed that a thorough study of the aphids of the apple and pomaceous fruits and the European literature upon them might be of considerable interest and value. After working along this line for two years, I have been able to ascertain some few points which seem reasonably certain; but one may well despair of ever securing any understanding of the descriptions of European writers, and, on the other hand, the more I collect the more distinctly different aphids I find upon the pomaceous fruits. As I started to prepare this paper it seemed well to take another look at the aphids now on the trees, to make doubly sure of some points. In doing so, three forms entirely new to me were found—one very common throughout Delaware this season and two others possibly only accidental, which will require further study. This only shows the great necessity for patient and exact study of our common aphids.

As above indicated, the previous literature upon the subject is most confusing, as has been remarked by almost everyone who has ever attempted to do any work with aphids. The descriptions of most European writers are very evidently entirely superficial, many of them seemingly disregarding the previous use of specific names, describing different insects under the same names, etc.

A. Pomi DeG.—But as to our native species, *A. mali* of Fabricius, Koch, et al., it seems should be known as *A. pomi*, under which name De Geer first accurately described both sexes. This species has been described by me as *A. padi* Linn., and very fully by Dr. Smith as *A. mali* Koch.

Apterous viviparous female.—The apterous females in spring and summer are light yellowish green, marked irregularly darker green and darker laterally, the head, antennæ, and legs yellowish, marked with black; the cornicles and cauda are usually black or very deep olive brown; around the base of each and between them orange; cornicles reach beyond end of cauda; cornicles straight and tapering.

These wingless forms are about 1½ mm. long, antennæ 1 mm., cauda 0.15 mm., and cornicles 0.35 mm. European writers do not mention the orange spots at the bases of the cornicles in descriptions of *A. mali*. Their *A. padi*, however, is very similar and possibly the same.

Winged viviparous female.—Head dark-olive brown, almost blackish; eyes black; antennæ yellowish brown; band across prothorax olive brown, sutures of prothorax light-green, lateral prothoracic tubercles small, sharp, meso and meta thorax dull black; legs yellowish brown, tips of femora and tibia and tarsi black; abdomen light green with brownish cross bands on sixth, seventh, and eighth tergites, small black spot laterally on each abdominal segment cephalad of cornicles, a large black tubercle immediately caudo-mesad of each cornicle; cornicles straight, tapering, black; cauda blackish.

Wingless male.—Yellowish brown; head darker, antennæ blackish, as long as the body, eyes black, rostrum blackish, reaching to caudal margin of first abdominal segment; legs brownish-black, middle of tibia lighter; genitalia black, forming a square and visible from above at sides of cauda; cornicles straight and tapering, black; cauda black; much smaller than the female, about size of nymph in third stage. The male was well described by De Geer and recently by Dr. Smith.

Apterous oviparous female.—Body light green, decidedly grass green at bases of cornicles, slightly pulverulent, lighter in front; head slightly brownish, antennæ with basal half light, distal half blackish; lateral prothoracic tubercles prominent, also tubercles on sides of first and seventh abdominal segments; sides of the abdomen (connexivum) become yellowish and body deeper green in older specimens; cornicles straight, black; cauda black, rostrum reaching to between meta-legs; genitalia black; subgenital plate black, and black on either side from it to side of base of cauda; next segment cephalad has a round black spot at either end of plate. The oviparous females are about the same size as the apterous females in May and June, but lack the red spots at the bases of the cornicles.

This species appears at Newark, Del., about the middle of May, the winged migrants occurring the first week in June and until late in July. The aphids are to be found upon the apple throughout the season. The true sexes appear and the eggs are laid somewhat earlier in the fall than are those of the other aphids on the apple, the first being found about October 15, 1901. The oviparous females, as well as the spring broods, curl the leaves quite badly, similarly to *A. sorbi*. This species is distinguished from *A. mali* Fitch by the red spots at the bases of the cornicles in the spring, their absence in the fall, the straight, tapering, black cornicles which are much longer than in *A. mali* Fitch, the males being apterous, and there being no winged full broods. There are about one-seventh as many males as females. *A. pomi* is attended by much larger numbers of ants (*Formica rufa*) than *A. mali* Fitch. I have found this species upon apple only.

A. mali Fitch (?).—This name is used merely tentatively until the true identity of the species may be determined. Fitch's apple aphis is quite distinct from *A. pomi* DeG. (*A. mali* Fab., Koch, etc.), and is by far the most common species in this country. *A. mali* as described by Walker[a] is undoubtedly the same species, and *A. pyri* and *A. cratægi* may prove to be synonyms, at least in part. I have found this species on apple, pear, and quince, almost equally common on either. A very slightly different form, possibly a variety, occurs commonly on the red haw (*Cratægus coccinia*).

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[a] Walker, Ann. and Mag. Nat. Hist., ser. 2, V, 276.

Apterous viviparous female.—Light yellowish green to dark green, with grayish bloom, embryonic young often showing yellowish in abdomen; dorso-mesal diamond-shaped bands and lateral margins grass green, sometimes forming three stripes; thorax lighter green; head rather yellowish, darker than abdomen, rusty around bases of cornicles and between them; cornicles yellowish brown, tips darker; cauda light; legs hyaline, knees and tarsi darker; distal segments of antennæ dark; antennæ with but six segments. This is considerably larger than the same form of *A. pomi.* About 2 mm. long; cornicles about one-half as long as those of *A. pomi.* Nymphs and adults quite variable in color.

Variety on red haw has small spots of white wax between dorsal and lateral stripes on first to fourth abdominal segments, though these are often wanting. Otherwise this and other forms the same as those on apple.

Pupa.—Similar to apterous viviparous female, except wing pads with dark tips.

Spring winged viviparous females.—On Cratægus. Head body color to dark olive, eyes reddish black; prothorax with olive collar and green margins and sutures; thoracic sclerites deep olive brown; abdomen shining green, often with grass green dorso-mesal stripe; four lateral black spots cephalad of cornicles on abdomen; usually a black dot in depression of connexivum on each abdominal segment; cornicles blackish, short, stout, slightly rusty; caudal tergites with dark cross stripes, cauda short, light.

Fall migrant winged viviparous female.—Head, antennæ, thorax, pleural oval spot on thorax, femora, tips of tibia, and tarsi black; prothorax light brown with dark brown chitinous anterior sclerite and two triangular spots caudad, yellow at bases of wings; abdomen green, darker green cephalad, sometimes yellowish or brownish; dark brownish spot on each abdominal segment cephalad of cornicles; deep rusty spot around bases of cornicles and between them; cornicles dark brown not straight or tapering; seventh and eighth tergites dark.

Winged male.—Occurring with winged female and very similar, but smaller, especially narrower, much more active; abdomen usually yellowish brown, though sometimes greenish; lateral spots obscure, often with faint blackish cross bands on abdominal tergites; cornicles brownish; caudal segments darker. Can be easily distinguished from the females by their greater activity.

Apterous oviparous female.—Yellowish green, becoming grayish or bluish green and finally blackish green; base of antennæ light, distal two-thirds blackish, with but five segments; eyes black, legs light yellowish brown, femora and tarsi black; cornicles short, blackish, surrounding bases of cornicles and between them orange or rusty; abdomen dark green laterally, and with blackish markings in older specimens. Red spots noticeable in nymphs, but not in nymphs of *A. pomi.*

The eggs of this species hatch about April 15. The adults maturing from nymphs borne by the stem mothers are winged, and appear during the first week in May. A partial third brood also occurs on the apple. The aphids are found thickly clustered over the buds as they burst, and on the young shoots, often seriously stunting them, and on the young leaves and blossoms, but do not curl the leaves. The winged broods migrate from the apple, and after the first part of June all my efforts to ascertain the summer food plants have failed. Professor Webster stated some years ago that he bred the species on wheat. I attempted to do this, both by transferring lice to wheat and by placing badly infested branches among wheat plants, but though occasionally one or two young were deposited on the wheat, they all died. Furthermore, adjoining and in an old orchard which was badly infested with the lice was a field of wheat, which I searched in vain for the apple aphids. The wheat was well infested with *Nectarophora granaria*, which would be readily confused by the casual observer, but which is easily recognized as of another genus by the entomologist. I did, however, find the apple lice rather common at first on a grass in the wheat, though I failed to find them on it later. All the grasses and weeds in and around this orchard were examined without finding any apple aphids. Late in October the fall migratory winged females and winged males return to the apple trees. At this time they are very abundant on bright days, swarming in the air, and readily seen in the sunlight. The bulk of the males appear slightly later than the winged females. The winged females are viviparous, giving birth to young which develop into the apterous oviparous females. The eggs are laid somewhat later than those of *A. pomi*, the first about November 1 and until the middle of November. The males have been repeatedly observed copulating with the oviparous females of *A. pomi* and *A. sorbi.* I at first thought that possibly *A. pomi* had two forms of males, as suggested by some European writers, but individuals taken in coitu proved to be true winged males of *A. mali* Fitch.

The rosy apple aphis (*Aphis sorbi* Kalt.).—This is the last of the three most common species of apple aphids to appear in the spring, the stem mothers being first found about May 1. The stem mothers and young occur among colonies of *A. mali* Fitch, but are at once easily distinguished from them by the brown color of the former. Their presence may usually be detected by the very close curling of the leaves which they inhabit.

The third and fourth generations of this species become winged and leave the apple during the first half of June. I have not found the summer food plant.

Apterous viviparous female.[a]—Stem mother. Length, 2.3 mm.; width of third abdominal segment, 1.15 mm.; length of antennæ, 1.75 mm.; III, 0.52 mm., IV, 0.35 mm., V, 0.23 mm., VI, 0.11 mm., VII, 0.46 mm. Tibia, I, 0.77 mm., II, 0.82 mm., III, 1.1 mm. Cauda, 0.02 mm.; cornicles, 0.31 mm. Rostrum reaching to between mesocoxæ. Dark purplish brown marked with black and covered with whitish pulverulence. Cornicles black; body very broad, tending to be globular; head bearing two ocelli-like structures on apex, as does the winged form, thoracic and first abdominal segments bearing distinct lateral tubercles, sixth and seventh abdominal tergites bearing a transversely oval, chitinous, black plate on the meson, bearing two short, blunt tubercles; cornicles reaching to end of abdomen, stout, tapering, distinctly flared at tip; cauda rudimentary, scarcely visible.

Apterous viviparous female, third series.—Considerably smaller than stem mother, general color pink with whitish pulverulence, marked with brownish especially at sides of abdomen and along thoracic sutures; cornicles tapering, yellowish base, tipped with black; last segment of antenna and joints blackish.

Pupa.—Length, 1.7 mm.; length of antennæ, 1.48 mm., III, 0.42 mm., IV, 0.27 mm., V, 0.17 mm., VI, 1.16 mm., VII, 0.45 mm. Tibia, I, 0.59 mm., II, 0.58 mm., III, 0.85 mm. Cornicles, 0.25 mm. Rostrum reaching to cephalad of meta-coxæ. Yellowish red to pinkish, with white pulverulence, decidedly pinkish in masses on leaves, wing pads, bases of antennæ, legs, bases of cornicles and rostrum yellowish-hyaline, eyes black, distal segments of antennæ and joints, tarsi, and tips of cornicles blackish, knees brownish.

Winged viviparous female.—Wing expanse, 6.25 mm., length, 1.70 mm.; length of antennæ, 2.1 mm., III, 0.58 mm., IV, 0.44 mm., V, 0.29 mm., VI, 0.13 mm., VII, 0.28 to 0.63 mm. Length of tibia, I, 1.00 mm., II, 1.00 mm., III, 1.28 mm. Cauda, 0.05 mm. Cornicles, 0.30 mm. Rostrum reaching to cephalad of meta-coxæ. Thorax shining brownish black, abdomen dark yellowish red, trochanters, bases of femora, tibia, and circles at base of cornicles light yellowish brown; cauda rudimentary; distal half of cornicles tapering and slightly flared at tips; seventh and eighth abdominal segments with two dorsal tubercles; third and fourth antennal segments thickly studded with sensoria, fifth segment with three sensoria; head with two ocelli-like structures on apex.

Winged viviparous females and winged males reappear on the apple similarly to those of *A. mali* Fitch during the latter part of October, the former giving birth to young, which become the apterous oviparous females.

My specimens correspond very closely to the excellent description of Kaltenbach. The peculiar tubercles upon the vertex of the head and the two caudal segments, as well as the large size of the blackish, globose stem mother, and the pinkish color of later spring broods, make the spring broods easily recognizable. The oviparous females are not so common, and are usually solitary. I have secured the fall winged female only by catching one giving birth to young, which developed into the oviparous females.

Fitch's *A. malifoliæ* has never been satisfactorily determined and seems to me to probably belong to this species. Parts of Buckton's *A. mali* and parts of *A. cratægi* and *A. pyri* of other authors very probably belong to *A. sorbi*.

The above descriptions are only partial, being designed to bring out only the most essential characteristics.

As before stated, I have also this fall found a quite distinct species of Mysus common on apple and pear trees throughout Delaware, and a reddish species of Rhopalosiphum on quince and pear, both of these being new to American literature, as as far as I can ascertain, though they may prove to be European species upon further study.

As regards remedies, I have been surprised to find that several sprays which are customarily recommended for the destruction of these and other plant lice are not always as effective as might be wished, and after considerable work with them I am by no means certain as to the best remedies.

Mr. Slingerland expressed especial interest in the paper, because he had spent most of his time for a year in obtaining similar aphid life histories. He had found that

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[a] Delaware Sta. Rpt. 1900, p. 190.

Aphis mali Fitch divided into two forms in the early summer. One form, winged migrants, went to June grass, the blossoms especially; later to *Poa annua* through the summer. Every alternate brood was winged, there being about thirteen broods in all. In the autumn they develop a new winged form which returns to the apple. Each winged viviparous female produced the oviparous. He thought it possible that they worked on the wheat in the fall.

He had noticed the brown form also, probably *sorbi*, curling the leaf of the apple through two or three broods. It then produced a winged migrant which was lost until fall, when it returned to the apple. He questioned whether it might not work on the roots of grasses during the summer.

Professor Smith noted the extensive abundance of Fitch's *mali* during the present season. The true *mali* was less abundant, but common.

The following paper, by H. Garman, of Kentucky, was read by the secretary:

THE TIME OF EMERGENCE AND OVIPOSITION OF THE SPRING BROOD OF THE HESSIAN FLY.

It has sometimes been assumed that the Hessian fly remaining in stubble emerges soon after wheat is cut and lurks about fields until fall before oviposition, or else lays eggs for an intermediate brood on volunteer plants. I am not aware that anyone has found larvæ or "flaxseeds" on plants of any sort during summer, to give ground for the assumption, and from my own observation of both wheat and Hessian fly I am disposed to regard the intermediate brood hypothesis uncalled for, and its truth very improbable.

Some facts gathered during the past summer and this fall lead me to think that the spring brood of "flaxseed" does not yield adults at all, or only in small numbers, during the summer, but lies dormant in the soil until wheat planting time in the fall, when the bulk of the adult emerges within a short period of time, apparently not extending over a week or ten days. The advantage of such an arrangement to the insect is apparent when one thinks about it, for if there were no particular limit to the time for the change to adult the chances of finding mates would be reduced, and the many accidents from storms, enemies, and the like, to which fragile insects of this sort are exposed would, before the end of summer, result in a large reduction in its numbers, already greatly reduced by the inroads of parasites.

In Kentucky there has been for several years past a steady increase in the injuries from the fly with a gradually increasing acreage in wheat. Some sowings were a total loss last spring. After harvest last spring I had a large quantity of badly infested stubble gathered and placed in breeding cages in the vivarium of my division. Adults were not secured from it during the summer. Though the material received the care customary in carrying insects through their transformations, it seemed probable toward fall, since the conditions were not exactly what they were in the fields, that flies had already emerged out of doors. This was in September, after some wheat had been planted in blue-grass Kentucky. Old stubble in various stages of disintegration was now gathered in an infested field, and on examination proved still to contain living "flaxseeds."

From both lots of stubble most of the flies came forth on the 1st of October and during three or four days following. They mated and began to lay promptly, showing in some cases something amounting to anxiety to be through with the process. One light frost had occurred before these flies emerged, and on the night of the 5th of October came a heavy frost that appeared to destroy all of the adults then out of the ground; but it did not reach the few "flaxseeds" still in the soil, and from these emerged, a few at a time, belated adults during the warm days following, as was demonstrated by plat experiments carried on on land that had been in infested grain.

On September 26, and each week thereafter, I had a plat of wheat planted on infested land with a view to getting the exact facts with reference to the length of time the females are engaged in placing their eggs. Upon wheat in these plats eggs were found as late as November 1. Some of the eggs were discovered on wheat planted October 17 and which was not up on October 26, the adults having emerged after the occurrence of two light and four heavy frosts.

But these eggs were rare, and in some cases were probably not fertile. This was true, at any rate, of some of the last laid in the vivarium, and a search of plants from the plats for larvæ appears to show that something of this sort occurred in the field. It is too early, of course, to make final statements of results from these examinations, since when larvæ are newly hatched they are likely to be overlooked; but it may be said as foreshadowing the result of final examination that 33 per cent of the plants from the plat planted September 26 is infested; 1 per cent of those in the plat sown October 3 is infested, and no larvæ at all have thus far been found in plants from plats sown respectively October 10, 17, and 24. But I expect yet to find a small percentage of infested plants in plats sown subsequent to October 3.

In concluding, the substance of what I have written may be put in a few sentences, as follows:

(1) The Hessian fly emerges here chiefly in the fall, at wheat-planting time.

(2) Adults may come out of the ground after several heavy frosts have occurred.

(3) Eggs may be laid on young wheat after October 26.

(4) At this latitude, during an average season, wheat planted as late as October 15 will suffer little injury from Hessian fly.

The paper was discussed by J. B. Smith, L. O. Howard, W. E. Britton, and J. M. Stedman. Attention was called to the great economic importance of the conclusions presented in the paper if these proved to be correct, and the evident possibility in that case of the treatment of the stubble. Opinion was expressed, however, that there were definite experiments to show summer immergence of the imagoes. Although the flaxseed was kept in some cases from June throughout the summer without immergence, this might probably be due to a faulty condition, especially in the amount of moisture, as the effect of damp weather upon the time of immergence has been noted.

The following paper, prepared by H. A. Morgan, of Louisiana, was read by the secretary:

LIFE HISTORY OF THE SUGAR-CANE BORER IN LOUISIANA.

A number of attempts have been made to determine the life history of the sugar-cane borer moth in Louisiana, but these have only resulted in obtaining the duration of the life cycle in summer. The problems connected with the hibernation of this pest have remained unsolved, and the many interesting economic questions associated with the winter phase of its history have been unknown.

In 1890 an attempt was made to ascertain the distribution of this moth in Louisiana, but the planters at that time regarded the amount of injury so insignificant that further investigation was postponed and more urgent work undertaken.

In the fall of 1900 many sugar-cane growers in the parishes of Ascension and Assumption began to detect an extreme attack of the borer and a consequent light tonnage and low sugar content. An investigation was asked for, and this short paper will contain some of the more important points of the life of the borer throughout the year.

As we wish to stress the hibernation period of this insect's existence, we shall begin with the deposition of the eggs of the moth in October and November. These are laid upon the leaves of the tops of cane (frequently upon the recently removed tops of cane lying upon the ground) and upon the young shoots springing from the stubble of early cut cane. These eggs hatch and the young caterpillars live gregariously upon the centrally coiled leaves of the tops for a few days, and then bore into the stalk either from above, or, as is frequently the case, many of them crawl down the stalk a few joints and enter it at the axils of the leaves, or around the nodes from which etiolated leaves have been cast. It is very exceptional that the late October and November depositions ever enter the pupa condition before March, and thus four and one-half or five months are spent in the larval stage during winter.

The tops from cane cut for fall planting contain so little stalk that they soon dry and become unfit for food, or are completely consumed by the cane trash fires. The planted stalks contain borers, but as the cane is permanently placed underground there is no danger whatever from the fall plant or from its trash.

The tops of windrowed cane (spring seed cane) are put down in October with the stalks, and two broods are buried in such plants—one brood of large borers, which infest the stalks, and another brood upon the tops in the egg condition, or as very young larvæ. The former brood usually perishes in the cane before it is removed for spring planting, but the latter easily survives the winter, damaging the eyes of the cane, as they usually enter the stalk at or near the eye.

The tops of cane cut for the mill may harbor borers of many stages, depending upon the time the cane is cut. Such tops contain from six to eight joints of immature cane and provide ample food for winter. They are thus regarded as a dangerous source of infection for the next spring, unless these tops be thoroughly burned or buried.

The caterpillars in the young shoots of stubble of early cut cane have a very unique way of protecting themselves when the freezes cut down the part of the shoot upon which they feed in early fall. As soon as their food becomes dry they migrate to the lower portion, which is invariably well below the surface of the soil and beyond the frost line. This portion of the shoot, too, is usually large and succulent and offers plenty of food for three or four specimens. Here they remain until the planter shaves the stubble in the spring, which process permits the moth an easy escape, as nearly all of the earth is removed from above the shoots in which the larvæ hibernate.

Early in March and in April all hibernating larvæ enter the pupa condition, and after from ten to thirty days the moths emerge and find plenty of young cane and corn upon which to deposit their eggs.

Corn has been found a common food plant of the spring and early summer broods. Its succulency advances development more rapidly than the young cane, and insures by its rapid growth a more abundant food for a colony of from ten to thirty or even more borers, which may prey upon a single stalk. The cycle of the spring and summer broods consumes from as many as sixty-five days to as few as thirty-three days, depending upon the food plant and atmospheric conditions (temperature and moisture), and thus the broods greatly overlap and become very irregular before fall.

The duration of the adults varies with the amount of moisture in the atmosphere. During an extremely humid period moths may live as many as eight days, during which time more than 500 eggs may be deposited. Under dry conditions moths die in two or three days after emerging, and may lay only 150 eggs.

Eggs hatch in from five to nine days after deposition, and, as stated above, the larval life varies with the weather conditions from twenty-three days to as much as five and one-half months.

The pupal life is also irregular. In the period of June, July, and August, only five days may be spent in this condition, while in March and April the pupal period may exceed thirty days.

Knowing as we do all the available hibernating media, as well as the fact that the moths are unable to extricate themselves from even one-half inch of soil, we feel warranted in predicting that the sugar-cane borer may be easily eradicated from Louisiana by a slight modification of the cultural methods now in operation upon sugar plantations.

L. O. Howard, of the United States Department of Agriculture, noted that during his study of the cane borer several years ago he had made recommendations to the planters in certain sections as to modifications, especially in cultural methods, similar to those suggested in the paper, and that the results had been entirely successful. It is probably due to a lessening of care in the matter that the borer has again become so abundant.

The following paper, presented by H. A. Gossard, of Florida, was read by the secretary:

Florida Observations; Experimental Work.

It is not my purpose in this paper to give a categorical treatment of all or even of a large number of the insects that have come under my observation during the past year, but rather to emphasize some of the interesting factors that affect the economic status of a few of the more important species, and I may add that my views regarding them have been formed from three years of residence rather than from one.

An entomologist reared in the Northwest and transferred to Florida will find after a very few years that the preconceived notions he carried with him into this semitropical land as to how insects ought to behave according to all of his previous observation and experience are often greatly astray. The factors that vary the course and make-up of our abounding life, such as drought and flood, sudden freezes and long drawn-out heat; stretches of heavy, virgin hammock soil full of humus, followed by all grades of land to wastes of sand; diversity of cultural and fertilizing practice; and yet again the irreconcilably contradictory "bug" theories and usages of our heterogeneous population of Southern planters, Northern settlers, and European immigrants give a capriciousness to local entomological phenomena at once entertaining and puzzling. Engaged in agriculture and horticulture in Florida will be found some of the keenest intelligence and best ability that is devoted to such pursuits anywhere in the world; and also following the same occupations will be found not a few of the most complacently self-satisfied people that live. Plantations, farms, orchards, nurseries, and gardens, faultless in appearance and condition, cultivated and cared for without stint of study, watching, labor, or expense, lift themselves in platoons or singly out of the wilderness like Eden gardens racing with each other and the rest of the world to hold most temptingly aloft a product that might well induce a man to take some risk on his life in order to make its acquaintance at closest range. Facing them, or at best at no great distance away, will always be found their neglected correlatives, unfertilized, uncultivated, unpruned, unsprayed, the nests of untold insects of all descriptions, noxious and beneficial, the incubating grounds of fungi, bad and good, a perfect medley of nature's work when her balance has been disturbed where life is lavish in its multiplicity and she has been left to straighten out the tangle quite alone. Contrasts of condition are violent, and whenever the always present potentialities of insect outbreak, influenced by whatever cause, burst over their bounds, the recovery of the disturbed equilibrium is often attempted by spasms, the countersallies of parasites, predaceous insects, and fungus diseases frequently being as sudden and violent as was the appearance of their objects of attack.

The rapid, thorough-going, business-like work of our natural friends is a revelation to the entomologist accustomed to their comparatively sluggish operations in the northern part of our country. It is true that he may have there found isolated cases where the possibilities of battling foe with friend received forcible and practical demonstration, but it is hardly putting the case too strong to say that he is about as well prepared from such observations to comprehend their work here as he would be to understand a tropical hurricane from having seen a hard thunderstorm. One is apt to forget when finding pests in excessive numbers that it is reasonable to expect that their enemies will be found multiplied in corresponding ratio. The foregoing are some of the elements that so often confuse expectations regarding local outbreaks and at the same time give a distinct tone of hopefulness to all old students of our entomological problems, considered in their general aspects. While almost every traveled and competent observer in our State will admit that Florida as a whole is as dirty, entomologically speaking, as it could well be, if there is one among them who believes that it is not as secure from the likelihood of great or long-continued insect disaster as any part of our country I have failed to meet that man.

So strong is the belief among some of our very intelligent and successful horticulturists that the proper mode of fighting pests is by means of their natural enemies that, even when visited by the worst pests we have, they prefer to receive the attack without interference rather than run the risk of destroying their friends with their enemies; of course, these men make some effort to introduce and encourage such allies as are known. While I do not believe this to be the most desirable course for all to follow, and am satisfied that from it many have suffered severe and unnecessary losses, the results reached by others have been highly gratifying. With such conditions and such a sentiment held by a large constituency, the logic of the situation necessarily points to an extension of the propagation and distribution of valuable insects and diseases as the coming policy of Florida's entomological officers.

Thus far it has been impossible to sufficiently unite State sentiment to secure the passage of any effective pest laws through the legislature. It would seem, however, that all might be willing to join hands upon a proposition to give State aid to a measure that makes the fulfillment of the foregoing idea its chief purpose. However, I would hardly expect such definite and tangible results from work of this character, unsupported by any of the quarantine and customary features of State laws, as would make it apparent that the benefits of the work were commensurate with the expenditures. Hence, so far as my personal influence is concerned, I shall favor a policy similar to that pursued by the State officers of California, emphasizing the propagation and dissemination of natural agents, and at the same time sacrificing as little as is consistent with success of the principles of legislation that have given effectiveness to such acts in other States.

To give some illustrations of the work of natural agents in Florida, I will record the following: About four years ago Professor Rolfs planted in an inclosure 25 or 30 trees of peach, plum, and Kieffer pear, with their branches interlocking, and infected a few—I think two of them—with San José scale, at the same time introducing the fungus *Sphærostilbe coccophila.* When I first saw the two originally infected trees at the beginning of 1899 the trunks had died back to the base, but clean, healthy limbs had sprung out below the point of death and were making a strong, vigorous growth. A few of the adjacent trees were just beginning to show the scale. During the summer the insects spread to nearly all of the peach and plum trees in the plat, not including pears, and threatened to destroy them the second season. However, spreading more slowly, but just as certainly as the scale, was the fungus and a minute ladybug, the two together finally striking a balance with the scale, so that if Professor Rolfs could see his trees to-day he would find them in far better shape than when he saw them last. No insecticidal treatment of any character has ever been given to these trees. Living scales upon them are hard to find at present, though upon one trunk is a plaster of scales and fungus tufts, with a ladybug here and there. If this plat had been larger it is probable that some of the trees would have died before relief reached them. I have no doubt at all that they will now remain indefinitely in first-class condition without insecticidal treatment.

Observations upon an adjacent orchard commenced at about the same time. How long it had been infested when I first saw it I can not say, but most of the pear trees were so nearly dead by 1900 that they were all dug up and destroyed. Adjoining the pears were several hundred peach and plum trees just beginning to show signs of scale in particular areas. With the exception of a single treatment with varying strengths of crude petroleum and kerosene during January and February, 1900, these trees have been allowed to take their own course. A very few have died outright, the limbs of others have succumbed, all have suffered, but a balance has been so nearly reached that further injury is unlikely. The beneficial agents in the orchard seem to have been the same as in the experimental plat, namely, the Sphærostilbe fungus and a very small ladybug, not *Pentilia misella*, but as yet undetermined. The scales have been perfectly cleaned from some trees upon which there has been no sign of fungus and I have been unable to find any other agent destroying them than this ladybug, which is sometimes found in squads of dozens upon trees that have just commenced to show infestation and hence furnish living scales. Where the two agents work in conjunction, it is perhaps impossible to decide which is the more efficient. A correspondent at De Land, Fla., also reports that for two or three years past some agent, presumably a predaceous or parasitic insect which he has been unable to discover, has been keeping the scale in first-rate control in the orchards of that vicinity. He introduced the Sphærostilbe into his orchard and says that it is doing good work. Like a wise man, however, his main reliance at the present time is upon his Deming pump. I believe it does not pay to lose two or three crops and some trees waiting for natural relief, but give these observations as suggestions of the possibilities of such procedure.

For suddenness and efficiency I have never seen any fungus disease do more satisfactory work than the one which swept off the cottony cushion scale for two summers, when the hot, rainy season began in July or August. If its period of activity could be extended over the whole year we would not need *Novius cardinalis*, an insect that has fully sustained its previous record since coming to Florida.

Were I choosing a locality in which to engage in orange culture in Florida, other things being equal, I would unhesitatingly choose to go into the heart of the districts affected by white fly, knowing well that natural relief is coming to such sections first. Some of the best growers in these districts are now depending wholly on the fungus diseases of the fly; and while I believe that these men are inviting loss upon themselves, I have no doubt at all that their policy will in time prove of more benefit to others, who resort to other means of warfare, than to themselves. Their present sacrifice means eventually the good of all.

The gray-headed fungus occurring upon the long and purple scales of the orange is, I believe, quite well distributed now, and when under full headway is certainly more efficient than the Sphærostilbe working upon the same scales. Where it is abundant I never advise spraying and have repeatedly been told of the satisfactory results that have followed giving it a chance. The work of the carnivorous pyralid, *Lætilia coccidivora*, has been emphasized by both Hubbard and myself in previous papers, and lack of time and space alone prevents my calling attention to others quite worthy of special notice. Our greatest need at present is an insect parasite of white fly; we feel confident that its advent can not be long deferred.

SECTION ON MECHANIC ARTS.

The Section on Mechanic Arts met in the red parlor of the Ebbitt House at 2 p.m., Tuesday, November 12. H. W. Tyler, of Massachusetts, presided, and the entire session was taken up in discussing the report of Chairman Tyler which he proposed to submit to the general convention as a report from the section as required by the constitution. Dr. Tyler's report outlined a general development in mechanic arts and engineering science as shown by correspondence which was carried on between officers of the section and most of the land-grant colleges. It furthermore outlined a general policy for future meetings in which more attention would be paid to the discussion of one or two broad engineering subjects rather than carry on the present programme of presenting a considerable number of isolated and independent technical discussions. The section approved the report of the chairman with the exception of those portions which made reference to anything that might be interpreted as a move to abolish the section.

The meeting on Wednesday, November 13, was called together at 2 o'clock by Chairman Tyler, and names for officers for the ensuing year were presented. H. W. Tyler, of Massachusetts, and F. Paul Anderson, of Kentucky, were nominated for chairman and secretary, respectively.

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